DIRECTOR

OPERATIONAL TEST & EVALUATION

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DEPARTMENT OF DEFENSE

ARMY

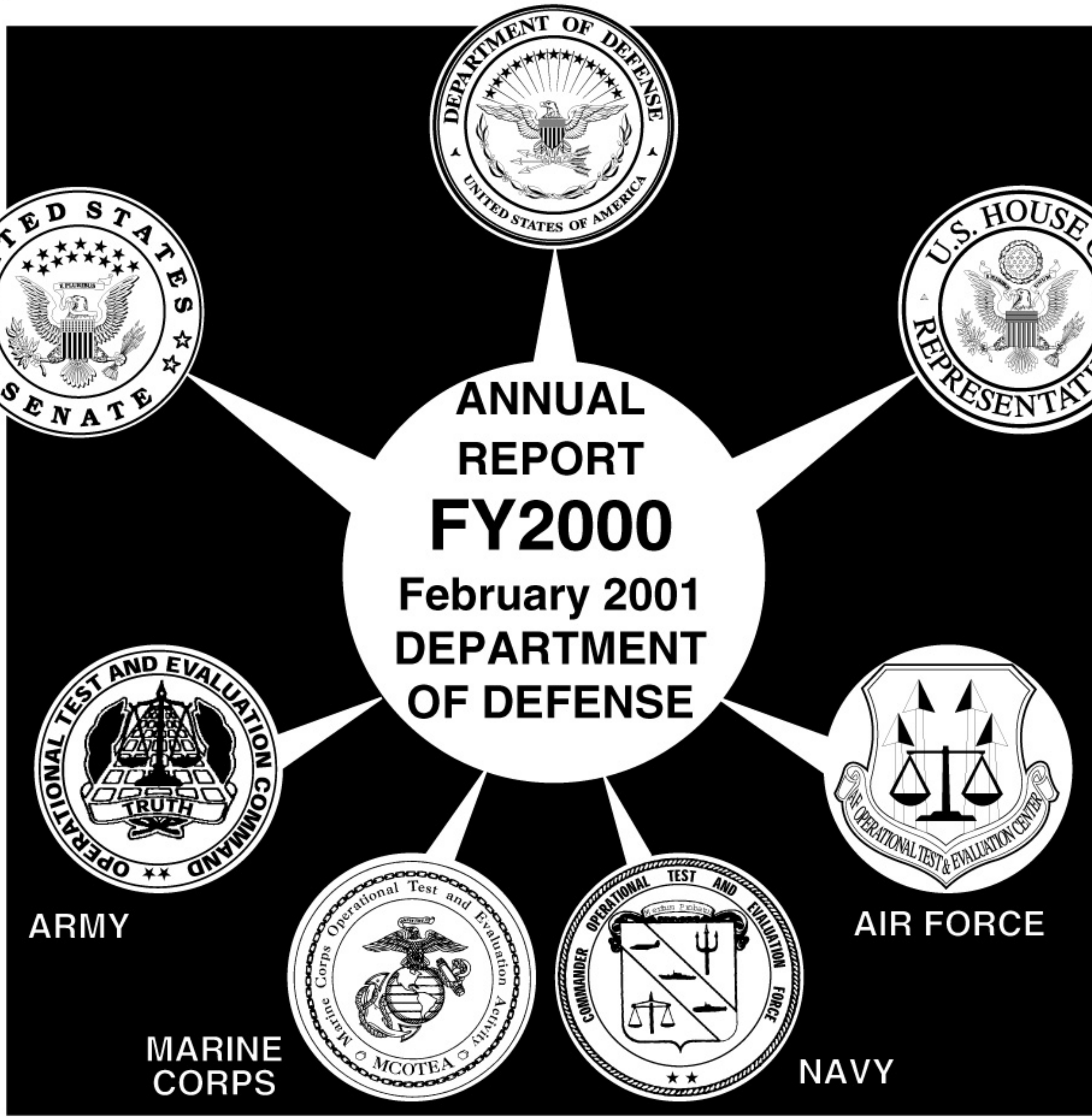
MARINE CORPS

NAVY

AIR FORCE

DIRECTOR

OPERATIONAL TEST & EVALUATION



NOTICE

This is an unclassified version of the FY 2000 Annual Report of the Director, Operational Test and Evaluation. In addition to this version, a classified annex is being submitted to the Secretary of Defense and the House and Senate Defense Committees pursuant to the provisions of Section 139, Title 10, U.S. Code.

This unclassified version has been published in response to Section 3013 of the Federal Acquisition Streamlining Act of 1994.

DIRECTOR'S INTRODUCTION

In my first Annual Report (1994), I identified what I believed, and still believe, to be the primary mission of operational testing. Operational Test and Evaluation (OT&E) must help ensure that when our soldiers, sailors, airmen, and marines must go into harm's way, they take with them weapons that work.

During the six years I have served as Director, Operational Test and Evaluation (DOT&E), the responsibilities and functions of the organization have grown significantly. In 1994, the Congress added Live Fire Test and Evaluation (LFT&E) to the DOT&E portfolio of responsibilities. The integration of the LFT&E Program into our mission has enabled us to examine and report weapons effectiveness, suitability, and survivability together. LFT&E is primarily driven by the physics of the failure mechanisms, while OT&E is heavily driven by the battle environment, and the tactics and doctrine practiced. Evaluating these factors together provides a more complete picture of overall effectiveness.

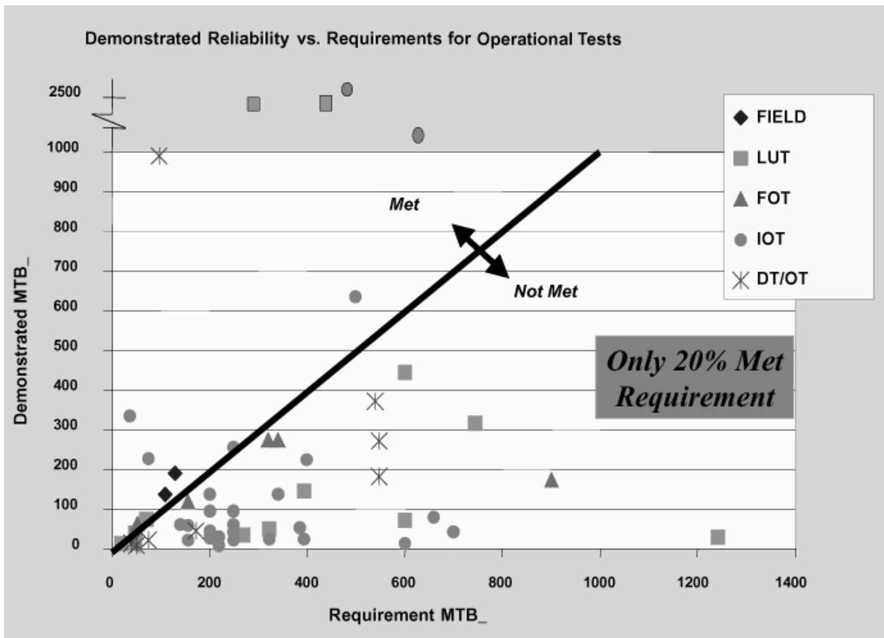
In June 1999, the Secretary of Defense approved a reorganization of Test and Evaluation (T&E) within the Office of the Secretary of Defense (OSD). This reorganization vested DOT&E with responsibility for the T&E infrastructure including stewardship of the Major Range and Test Facility Base (MRTFB) and management of the Central Test and Evaluation Investment Program. These new responsibilities have helped to streamline defense acquisition with contributions from test personnel earlier in the life of an acquisition program. The reorganization also helps ensure that weapons systems are realistically and adequately tested and support complete and accurate evaluations of operational effectiveness, suitability, and survivability/lethality to the Secretary of Defense, other decision makers in the Department of Defense, and Congress.

THE STATE OF TESTING IN THE DEPARTMENT OF DEFENSE

During my tenure as the Director, Operational Test and Evaluation, I have expressed concern over the growing gap between T&E requirements and T&E resources. While T&E requirements and the complexity of weapon systems under test have increased, the resources for test and evaluation have declined dramatically. The greatest challenge has been to absorb the significant T&E personnel and funding reductions associated with defense downsizing while continuing to accomplish the T&E mission. Some of these reductions were accommodated through business process reengineering and investments that promoted efficiency. For example, the Kwajalein Modernization and Remoting Project, scheduled for completion in FY03, will enable Kwajalein Missile Range to operate with the 20 percent reduction in staff and $17 million a year reduction in annual operating costs that have already been taken from their budget. Unfortunately, many other reductions resulted in less testing being done to support acquisition programs and delays in needed upgrades and repairs at test facilities. The impact of reductions can be seen in the doubling of Army systems that failed to meet reliability requirements in Operational Testing (OT) between FY96-FY00 compared to FY85-FY90. The impact of increasing test facility equipment failures can be seen at the Arnold Engineering Development Center in Tennessee, where failures in plant heater, transformer and motor equipment, and a propulsion wind tunnel starting motor resulted in unexpected repair costs of $4.6 million during FY00 and delays of test programs from one fiscal year to the next.

Pressures from tight budgets and schedules have caused acquisition program managers to cut back on developmental testing to save time and money. Yet, reductions in developmental testing only postpone the discovery of problems to operational testing when they are more expensive and difficult to address. Program managers control the content and execution of the developmental test program, as I believe they should. However, cost and schedule pressures are increasingly causing program managers to accept more risk and it is showing up as performance shortfalls in operational testing.

There has been a disturbing trend of programs entering dedicated OT&E without having completed sufficient operationally relevant developmental test and evaluation. In recent years, 66 percent of Air Force programs have had to stop operational testing because the system under test was not ready for operational test due to some major system or safety shortcoming. Since 1996, approximately 80 percent of Army systems tested failed to achieve even half of their reliability requirements during operational testing.



source: ATEC/AEC

Figure 1. *Army Operational Test — Demonstrated Reliability Versus Requirements*

The Marine Corps V-22 Osprey program reduced developmental testing due to cost and schedule pressures. The original Flight Control System Developmental and Flying Qualities Demonstration Test Plan call for 103 test conditions to be flown. In an effort to recover cost and schedule, the conditions to be tested were reduced to 49, focusing on aft center of gravity conditions thought to be most critical. Of the 49 conditions, 33 were flight-tested.

I am also concerned about the Navy's use of waivers. In the case of the V-22 Osprey, developmental testing showed that the V-22 had failed to meet established thresholds for overall mean time between failures and for false alarm rate of the Built-In Test system. The Navy waived these criteria. In addition, the Navy approved waivers for test requirements identified in the Test and Evaluation Master Plan. These included tests of operations in icing conditions or performing air combat maneuvering. Such waivers are permitted under Navy acquisition instructions. DOT&E does not endorse this practice and does not view the Joint Operational Requirements Document requirements as waived for our evaluations. Waivers for significant performance and test parameters should be discouraged.

Each of the Services has been looking into these trends and has initiated steps to address them. DOT&E will continue to monitor these trends and work with the Services to make appropriate process changes.

THE GAP BETWEEN T&E WORKLOAD AND T&E RESOURCES CONTINUES TO GROW

Major Range and Test Facility Base workload has remained robust for many years and is increasing at some MRTFB activities, yet funding for T&E infrastructure and investment has steadily declined. OT&E costs are a minuscule part of acquisition programs—typically less than 1 percent—and developmental testing is typically only a few percent, yet testing capabilities are under constant attack during the Department's budget processes. Operating and investment funding has been reduced approximately $1 billion a year compared to FY90 levels, a 30 percent reduction totaling $8 billion between FY90-FY01. The Service test ranges do their best with old equipment and facilities to test the newest, most modern weapon systems. Compounding the problem is the loss of military and civilian personnel who perform test and evaluation. MRTFB manpower has been reduced 32 percent or approximately 14,000 people. Military manning levels have been reduced 45 percent, dramatically decreasing military participation in early T&E. Military manning levels at Army MRTFB activities have been reduced approximately 99 percent. In 1995, I began saying that we must reverse this trend, and I have worked hard to do so, with limited success.

The Service Operational Test Agencies (OTAs) are also under severe resources pressures. The challenges of personnel downsizing and budget cutting have diminished their strength and ability to do their mission. As the Director, Operational Test and Evaluation, I have worked hard to resist institutional actions by the Services that could adversely affect the strength, independence, or objectivity of the OTAs. The Service OTAs continue to be one of the best bargains, dollar for dollar, anywhere in the Department of Defense. Yet, the Service OTAs continue to struggle with the gap between OT&E requirements and resources.

ARMY OPERATIONAL TEST COMMAND

- Projected workload increase of 240 percent not realized because Test and Evaluation Coordination Offices were not able to perform projected OT&E for small programs.
- Military work force was reduced 61 percent between FY93-FY00.
- Civilian work force was reduced 50 percent between FY93-FY00.

NAVY OPERATIONAL TEST AND EVALUATION FORCE (COMOPTEVFOR)

- Workload increased 28 percent between FY93-FY00 to an historically high level.
- Funding was reduced 10 percent between FY90-FY00.
- Civilian work force was reduced 23 percent between FY93-FY00.

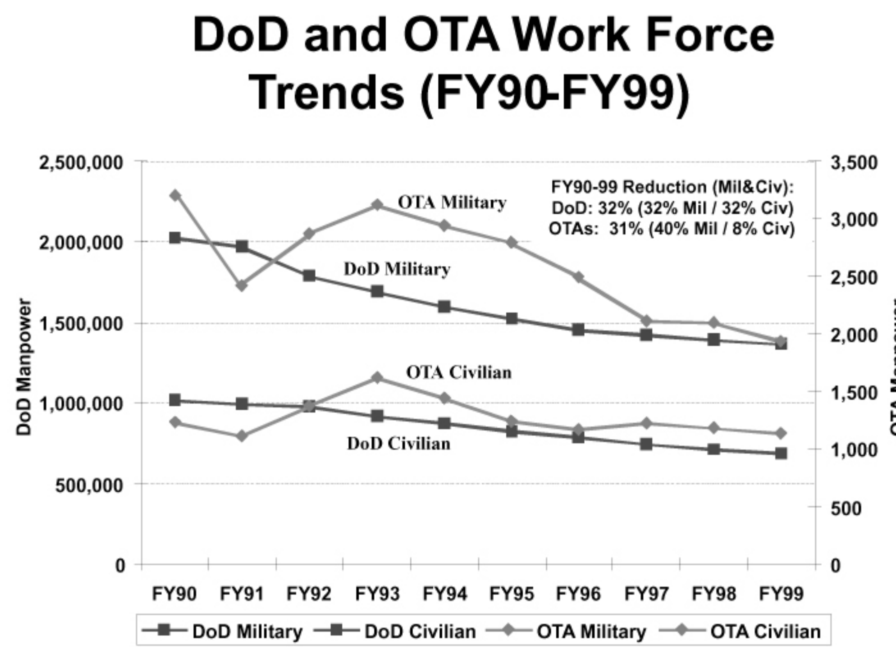
MARINE CORPS OPERATIONAL TEST AND EVALUATION ACTIVITY

- Workload increased about 200 percent between FY93-FY00.
- Military work force was reduced 32 percent between FY93-FY99, leaving only 21 Marines.
- Civilian work force was reduced 14 percent between FY93-FY00, leaving only 12 people.

AIR FORCE OPERATIONAL TEST AND EVALUATION CENTER

- Workload increased over 200 percent between FY93-FY00.
- Funding for initial operational test and evaluation decreased approximately 12 percent.

- Military work force was reduced 3 percent between FY93-FY00.
- Civilian work force was reduced 24 percent between FY93-FY00.



In its 1999 report, the Defense Science Board (DSB) Task Force on Test and Evaluation recommended, "The focus of T&E should be on optimizing support to the acquisition process, not on minimizing (or even 'optimizing') T&E capacity." Despite the wisdom of this recommendation, there continues to be a lack of adequate T&E resources necessary to support the acquisition process. In FY01, the Army Test and Evaluation Command is facing a shortfall of $8.7 million for the conduct of approximately 39 Acquisition Category II-IV operational tests. The Air Force Operational Test and Evaluation Center is facing a potential funding shortfall for operational test requirements that could affect 20 of 49 test programs. The Marine Corps Operational Test and Evaluation Activity does not have adequate resources to support nuclear, chemical, and biological defense OT requirements. The Navy COMOPTEVFOR is dependent on acquisition programs to fund early participation by operational testers in acquisition programs when deficiencies are least costly to fix.

When the Service OTAs do not have adequate resources to accomplish their mission, acquisition programs are either delayed or forced to fund the shortfalls by diverting funds from other activities. In some cases, constrained operational test budgets force the Service OTAs to only focus on the highest profile programs, with small and medium-sized programs proceeding into production without formal evaluation and reporting by the OTAs. The House of Representatives Committee Report on the Defense Appropriations Bill for Fiscal Year 2001 accurately stated that operational testing, especially in the smaller programs, is not being adequately funded.

> "The Committee is concerned that the Military Departments are not adequately budgeting for operational testing. The Committee understands that severely constrained operational test budgets are forcing the Services' operational test communities to focus reporting only on the highest profile programs with small and medium sized programs proceeding into production without formal reporting from the operational test community. The Committee believes that this situation must be corrected and fully expects the Military Departments to budget adequately to ensure all programs benefit from an appropriate level of independent operational testing."
>
> House of Representatives
> Committee on Appropriations
> Report 106-644
> *Department of Defense Appropriations Bill, 2001*

Inadequate manning at OTAs and MRTFBs, including military manning, also has a detrimental impact on acquisition. For many years, I have pointed out that the loss of soldiers at Army MRTFB activities has hurt Army developmental testing and put Army acquisition programs at risk when they reach initial operational test and evaluation. I was surprised to learn that the FY01 Army Officer Distribution Plan would provide officers to the Army Test and Evaluation Command at even lower levels than in the past. I have worked with the Army to try to address this situation. However, the FY01 Army Officer Distribution Plan still provides only 65 percent of its authorized officers. I do not believe that this is adequate to ensure mission accomplishment. The problem is particularly critical when it comes to Majors and Captains, which are Test Officer positions in the Operational Test Command and the Evaluators in the Army Evaluation Command. I am also concerned about the Marine Corps Operational Test and Evaluation Activity's ability to adequately accomplish its mission with only 21 military and 12 civilian personnel.

T&E INVESTMENT IS NOT KEEPING PACE WITH WEAPON SYSTEMS TECHNOLOGY

I remain concerned over the low rate of investment in T&E capability. Since FY90, T&E investment levels have been reduced more than 28 percent while military construction funding for T&E facilities has decreased over 90 percent. Clearly, additional funding is necessary to maintain the aging capabilities and keep pace with advancing weapon systems technologies.

Weapon technologies are outdistancing our ability to adequately test systems as they are developed. My office has worked with the Deputy Under Secretary of Defense for Science and Technology (S&T) to establish an S&T program for T&E to accelerate the development of critical technologies for T&E. An applied research and advanced technology development program to exploit new technologies and processes to meet important T&E requirements, and expedite transition of these technologies from the laboratory to the T&E community, will ensure that technology is in place in time to support critical test events. This science and technology program for T&E will provide the essential knowledge base and lay the groundwork for building the T&E capabilities of the future.

The Air Force has conducted several excellent studies that point to the need for a designated range complex to provide testing for on-orbit systems to verify space system performance, prove system utility and expanded space systems concepts, inject space systems participation into training and exercises to enhance realism, and build warfighter confidence analogous to the air test ranges. Basic space test capabilities exist, but are not sufficient to meet space mission area testing requirements. Probable infrastructure needs include improved instrumentation; improved connectivity among ranges and range users; improved range scheduling and coordination capabilities; and more traditional test range processes, data collection, and safety control. The Air Force Space Command and Air Force Materiel Command are jointly developing a space test process and range concept. My office is working with these organizations and supports their efforts.

In response to a formal request from Under Secretary of Defense (Acquisition, Technology and Logistics) (USD(AT&L), my office assessed the status of resources to support interoperability testing and identified the need for a hardware-in-the-loop, system-of-system level interoperability network. My office has initiated a proof of concept initiative, leveraging existing assets, to validate the feasibility and utility of the network concept before pursuing a major investment.

There is also a need for a national commitment to new transonic and hypersonic wind tunnel capability. Transonic wind tunnels have made major contributions to aircraft design and performance for the past 50 years and that role is expected to continue. U.S. test facilities that are used for military and commercial aircraft development are almost 50 years old. In the transonic region, our European allies have a new, efficient facility with high data throughput. A new U.S. high reynolds number transonic wind tunnel, which produces data cheaply and efficiently, is essential. This will provide reliable performance data needed by both our military and commercial aircraft designers. Several DoD, NASA, Air Force, and industry studies on this issue over the past 15 years are in agreement as to the criticality of this need. Test facilities that can simulate the high-temperature, high-pressure hypersonic flight environments are also needed to support the development and fielding of air breathing hypersonic flight systems.

The requirements for some of these test needs are well documented, while for others it will take time to develop detailed requirements. But, it is critical that we continue this process to ensure that needed test capabilities and facilities are available to support future weapon systems concepts and integrated warfighting capabilities.

STRATEGIC PLANNING FOR T&E

Since assuming responsibility for OSD stewardship of the MRTFB in September 1999, my office has been working with the Services to address the immediate problems and to undertake a strategic review and planning process to address the long-term health of the T&E community. The T&E Executive Agent (EA), comprised of the Service Vice Chiefs and myself, are working to institutionalize a strategic review of what it will take to bridge the gap between today's capabilities and tomorrow's technology. Our desire is for the Department to have the necessary T&E capabilities to thoroughly and realistically test and evaluate weapons and support systems for the warfighter. The EA has developed a series of goals that focus on the developmental and operational test work force, the decision makers, defense planners, infrastructure investments, policies, strategic partnerships, and test environments.

My office is also actively working with the training community to leverage instrumentation development efforts and reinvigorate strategic planning for instrumentation. As part of the reorganization of OSD T&E discussed above, I became chair of the Defense Test and Training Steering Group (DTTSG). The DTTSG brings together the test and training communities on common themes. Its mission is to oversee requirements, development, and integration of all training and test range instrumentation, and to facilitate the development of a consolidated acquisition policy for training and test capabilities, including embedded test and training capabilities in weapon systems. The Defense Test and Training Steering Group's current major activities are developing Sustainable Ranges Action Plans for the Senior Readiness Oversight Council and the development of a Joint Test and Training Roadmap.

THE SECRETARY'S THEMES

In May 1995, Secretary of Defense William J. Perry articulated five themes that have provided strategic direction for T&E during the last six years. These themes have been guides for change in the T&E process and have been regularly emphasized by Secretary William Cohen. They are:

- Earlier involvement of operational testers in the acquisition process.
- More and more effective use of models and simulations.
- Combining, where possible, different types of testing.
- Conducting operational testing and training exercises together.
- Using operational testing to support Advanced Concept Technology Demonstration (ACTD) programs.

Implementing these themes can and has saved millions of dollars in major acquisition programs and reduced program cycle times substantially. I believe this next section demonstrates that these themes have been effective in introducing needed change.

Theme 1: EARLY INVOLVEMENT

Operational testers should be involved from the outset when system requirements and contractor Requests for Proposals are being formulated. This early involvement contributes to earlier understanding of how systems will be used once they are fielded and identifies the tools and resources needed to achieve understanding. Proper early planning can also facilitate more efficient use of technical data from developmental testing in the operational test and evaluation process.

Early involvement of operational testers provides early feedback to help acquisition programs address operational issues. These issues are often missed in contractor and developmental testing. As the USD(AT&L) explained in a letter to the chairmen of the four Defense Committees, "I have advocated for many years that serious testing with a view toward operations should be started early in the life of a program. Early testing against operational requirements will provide earlier indications of military usefulness. It is also much less expensive to correct flaws in system design, both hardware and software, if they are identified early in a program. Performance-based acquisition programs reflect our emphasis on satisfying operational requirements vice system specifications."

The Under Secretary of Defense for Acquisition, Technology and Logistics, has consistently supported this approach. For example, in his memo of December 23, 1999, Dr. Gansler recommended to the Service Acquisition Executives that they "seek out the involvement of the operational testers in reviewing the acquisition strategy and operational requirements for all ACAT II, III, and IV level programs as well as ACAT I." He also recommended that the acquisition strategy or operational requirements development not be considered complete until the Service OTA has coordinated on it.

Part of our approach to early involvement is to call for Early Operational Assessments (EOAs). Two of many noteworthy examples of the benefits of early insight can be found in EOAs for the LPD-17, conducted by the Navy's Operational Test and Evaluation Force in 1996, and NMD testing conducted by Army Test and Evaluation Command this year.

While early involvement requires only modest resources, these resources are not available. As budget and personnel pressures have increased on the Operational Test Agencies, their ability to provide early insights to acquisition programs has decreased.

A July 2000 GAO report on "BEST PRACTICES: A More Constructive Test Approach Is Key to Better Weapon System Outcomes" came to a similar conclusion but states it rather differently, namely, that we are testing too late.

> "To lessen the dependence on testing late in development and to foster a more constructive relationship between program managers and testers, GAO recommends that the Secretary of Defense instruct acquisition managers to structure test plans around the attainment of increasing levels of product maturity, orchestrate the right mix of tools to validate these maturity levels, and build and resource acquisition strategies around this approach. GAO also recommends that validation of lower levels of product maturity not be deferred to the third level. Finally, GAO recommends that the Secretary require that weapon systems demonstrate a specified level of product maturity before major programmatic approvals."
>
> GAO Report,
> July 2000

The implementation of earlier testing and evaluation is, of course, very much in the hands of the Acquisition program offices. Testers cannot make this happen alone. The money to do early testing is, for the most part, under the control of the Service Acquisition Executives, Program Executive Offices, and Program Managers, as it should be.

Theme 2: MODELING AND SIMULATION

Test and evaluation should make more effective use of Modeling and Simulation (M&S). Realistic and highly predictive models and simulations are needed that contribute to a real physical understanding of the system being modeled. The kind of M&S that truly contributes to reducing the scope and risks of testing is neither conceptually easy nor inexpensive.

In 1996, the Under Secretary of Defense (Acquisition & Technology), Dr. Paul Kaminski, directed that plans for M&S should become an integral part of every Test and Evaluation Master Plan. He said, "This means our underlying approach will be to model first, simulate, then test, and then iterate the test results back into the model." The reality is that our program management structure often does not make the investments necessary for M&S to be an effective contributor. In part, this is because the payoff from using modeling and simulation is often years down the road from the point of commitment of funds. Accordingly, the program manager can expect that he or she will be long gone before the benefits arise. This is also true in acquisition program support of the T&E infrastructure.

For this reason, a 1999 Defense Science Board Task Force on Test and Evaluation recommended that the acquisition process require and fund an M&S plan at the earliest practical point in a program.

The DSB recommended that oversight and direction of M&S development and employment for T&E be carried out by an OSD T&E organization.

Since that DSB Task Force, my office sponsored a survey of M&S practices in acquisition programs. That survey indicated fewer than half of the programs had an M&S staff, fewer than half had a "collaborative environment" for M&S, and less than two-thirds had an M&S plan or mentioned M&S in the contract. The USD(AT&L) incorporated five recommendations from the survey results in the upcoming version of DoD 5000.2-R (Mandatory Procedures for Major Defense Acquisition Programs and Major Automated Information System Acquisition Programs). These recommendations are that:

- M&S plans be developed and co-signed by the testing community.
- M&S be used to make pre-test predictions, and that test results be used to validate the M&S.
- M&S be used to validate interoperability.
- M&S be deliverables.
- The government identify any M&S that will be used to evaluate proposals.

If implemented, this should go a long way toward improving the situation.

Theme 3: COMBINING TESTS

A combined developmental/operational test period is now common in most test programs. Two-thirds of the programs under our oversight now use a combined developmental/operational test period as part of the overall test program. The effective combination depends on early efforts by the OTAs to make the developmental testing more realistic, complete, and operational. Progress here has been constrained by the resource pressures on the OTAs. Of course, there is still a need for a period of dedicated OT&E independent of developer and contractor.

This theme can be applied to interoperability testing as well. For example, it is possible to combine the operational tests of different systems, something that is necessary in testing the Department's system-of-systems concepts. Some progress has been made, for example, in combining the M1A2 System Enhancement Package and Bradley A3 operational tests.

Theme 4: TESTING AND TRAINING

Training exercises often provide the complex environment and the kind of stressing conditions needed for operational testing. Similarly, operational tests can add threat realism and rigorous data collection that can be valuable to training. Together, testing and training employ many of the same resources, often at the same range. Combining testing and training can yield big returns for relatively small investments of money and personnel. Many of the programs under our oversight now combine test and training events to gather operational test data.

Since systems are sometimes operationally deployed before OT, we have used experience from operational deployments as a complement to, or substitute for, some aspects of operational tests. An example is the Joint Surveillance Target Attack Radar System (JSTARS) and its Common Ground Station (CGS). JSTARS represented the first large-scale application of this approach during the deployment of JSTARS in Operation Joint Endeavor in Bosnia and for the CGS during exercises in Korea this year.

Theme 5: ADVANCED CONCEPT TECHNOLOGY DEMONSTRATIONS

The fifth and final theme is the importance of using operational testing to support Advanced Concept Technology Demonstration (ACTD) programs. The challenge is to apply the techniques of operational testing in ways that support the ACTD process. To meet this challenge, testers will confront situations where the requirements definition process may be very informal and subject to change. Here again, the emphasis must be on providing understanding regarding an ACTD's contribution to military utility and being creative in defining ways to provide that insight. A critical element to success in ACTD testing is the establishment of effective working partnerships with the Commanders in Chief (CINC). ACTD programs are typically sponsored by a CINC. Just as in the traditional acquisition programs, testing in the ACTD context must be aimed at providing early insight and understanding.

The Predator unmanned aerial vehicle provides an excellent example of bringing operational test insights into play in an ACTD. Here the OT&E community was involved early, used DT test data to help assess system capabilities, and participated in observing and then evaluating the system's experience during deployment in Bosnia.

I believe the "bottom line" cumulative effect of the five themes can be summarized in four words—"making it all count." Earlier involvement, better use of M&S, combined testing, innovative OT&E in the ACTD process, and combining of testing and training are all ways to maximize the contributions of the T&E community and "make them all count."

DOT&E RESOURCES

In FY00, DOT&E programs were funded at $217.722 million. The table below provides a breakout of the DOT&E appropriation. The $7.0 million congressional add for the Live Fire Testing and Training Initiative is included in the Live Fire Testing program. Congressional support for this initiative has been steadfast. The Central Test and Evaluation Investment Program funding includes the following congressionally directed programs: Roadway Simulator ($10 million), Airborne Separation Video System ($4 million), and the Magdalena Ridge Observatory Program ($3.5 million).

Program Element	FY00
Operational Test and Evaluation	$14.602M
Live Fire Testing	$16.669M
Test and Evaluation	$53.585M
Central Test and Evaluation Investment Program	$132.866M
Total	$217.722M

LIVE FIRE

Fiscal Year 2000 saw the culmination of efforts initiated by DOT&E in July 1998. In 1998, DOT&E initiated an effort to clarify LFT&E policy within DoD. Together with Army, Navy, and Air Force Test and Evaluation executives, we drafted new regulations consistent with Live Fire Test legislation. In 2000, these changes were incorporated into DoD Regulations (DoD 5000.2-R). The changes: (1) clarify existing DOT&E policy requiring M&S predictions prior to Live Fire tests; (2) require evaluation of U.S. platform vulnerability to validated directed energy weapon threats; and (3) define LFT&E procedures and requirements for programs lacking a defined EMD or B-LRIP milestone.

My Live Fire Directorate has been very active in making the best use of modeling and simulation in T&E. The Live Fire Test program, perhaps more than any other testing activity, continues to add discipline to the exercise and evaluation of modeling and simulation in support of acquisition. Live Fire Test policy requires a model prediction to be made prior to every Live Fire Test. This policy has focused attention on test instrumentation, test issues, and shot sequencing, as well as model adequacy.

DOT&E was responsible for the oversight of 90 LFT&E acquisition programs during FY00.

NEW OPERATIONAL TEST AND EVALUATION POLICIES

On November 17, 1999, my office issued an Information Assurance Test and Evaluation Policy, which included guidelines on metrics for operational testing for information assurance. These guidelines are provided as a resource to assist testers and program managers in properly implementing the policy. In addition, we sponsored the first annual Information Assurance T&E Conference in Albuquerque, NM, from October 31-November 2, 2000. This conference brought together a broad cross-section of personnel with both T&E and information assurance backgrounds from the Services, DoD, and other government agencies, as well as industry and academic representatives.

On October 25, 1999, my office issued policy on Operational Test and Evaluation of Electromagnetic Environmental Effects (E^3). Our efforts in FY00 focused on working with the Service Operational Test Agencies and the Joint Spectrum Center (JSC) to develop the implementation plan for the policy. Coordination has taken place via monthly DoD E^3 integrated planning team meetings. The JSC developed a draft guidance document on E^3 assessment for program managers. DOT&E published a "how to" document in the Program Manager magazine. In addition, DOT&E hosted the first workshop on E^3/SpectrumManagement testing in September 2000.

CINC PARTNERSHIPS

As noted earlier, the Secretary of Defense has asked the Director, Operational Test and Evaluation, to help provide greater support for the warfighting CINCs. During 1996, we began several initiatives. One of these initiatives is making good use of CINC exercises for operational tests of military equipment. As stated above, a second initiative with the CINCs is to bring operational test insights to ACTDs. The CINCs are the sponsors of ACTDs, and a close working relationship with them in the testing of ACTDs is essential. I consider both of these initiatives successes.

Secretary Cohen has said, "It is essential that new operational concepts be tested by a full range of joint and Service warfighting experiments to develop a new joint doctrine." As new operational concepts and technologies are proven, they will lead to changes in the organization, employment of forces, and doctrine. Operational testing is an important way in which new concepts are tested, and operational testing can contribute further in this arena. This was the recommendation of the Blue Ribbon Panel in 1972, and remains particularly applicable today as the military is transformed in accordance with the Defense Planning Guidance.

> "A key to our success was the technical assistance provided by DOT&E for the C⁴ISR Systems and Process Assessment."
>
> Major General R. Steven Whitcomb, Assistant Chief of Staff, CJ3, USFK
> June 8, 2000

The Year 2000 (Y2K) challenge created an opportunity for DOT&E to provide direct T&E support to the Unified and

Specified Commands. A Deputy Secretary of Defense memo dated August 24, 1998, directed DOT&E to provide technical assistance in support of JCS-directed Y2K activities. DOT&E provided the CINCs with highly qualified OT&E support to the Y2K assessment process. Following on the success of that initiative, DOT&E is providing direct on-site support to the CINCs at their request.

The 1999 Unified Command Plan (UCP-99) tasks the CINCs to conduct outcome-based interoperability assessments of fielded systems and to provide readiness implications of issues and deficiencies identified within their area of responsibility. In support of this, DOT&E provides on-site and reach-back OT&E support to advise the CINCs on how best to focus evaluation objectives; develop evaluation strategies; design test and evaluation plans/programs; evaluate operational performance; and identify and track corrective actions. This OT&E support helps relate operational issues, evaluation objectives, measures of effectiveness, and data collection requirements to operational requirements developed with quantifiable and testable metrics. This support is integrated with military exercises, operational assessments, Advanced Concept Technology Demonstrations, joint experiments, joint test and evaluations, and other mission-based operational performance evaluations to address readiness implications within the individual commands.

Operational Capability
Assessment Process
(OCAP)

The Y2K effort became a model for our CINC partnerships. Since then, we have worked with the CINCs to institutionalize an Operational Capability Assessment Process to capture what is learned, track the solution, and confirm it in subsequent exercises. In conjunction with U.S. Joint Forces Command, DOT&E is sponsoring development of a set of software tools designed to further assist the warfighting CINCs in assessing outcome-based interoperability and the impact on mission-based operational capabilities. On-site support includes guiding development of these web-based tools to suit the specific needs of the individual CINCs. Battle Laboratories and Operational Test Agencies may use these same tools to help assess Advanced Technology Demonstrators and ACTDs for CINCs, as well as conduct early operational assessments for acquisition systems.

EXTERNAL REVIEWS BY THE DEFENSE SCIENCE BOARD

DOT&E regularly supports external reviews of our performance. In the fall of 1999, the Defense Science Board Task Force issued a very positive report with many helpful findings. These findings were summarized in our 1999 Annual Report.

In 2000, there was a new review by the Defense Science Board Task Force on Test and Evaluation. Section 913 of the Fiscal Year 2000 Defense Authorization Act directed the Secretary of Defense to convene a panel of experts, under the auspices of the Defense Science Board, to conduct an analysis of the resources and capabilities of the Department of Defense, including those of the military departments. This new study was to identify opportunities to achieve efficiencies, reduce duplication, and consolidate responsibilities in order to have a national T&E capability that meets the challenges of Joint Vision 2010 and beyond. The new study of the Defense Science Board Task Force on Test and Evaluation Capabilities was conducted during 2000. The final report is in coordination at this time.

EXTERNAL REVIEW BY THE NATIONAL RESEARCH COUNCIL ON TESTING FOR RELIABILITY

The 1998 National Research Council study of *Statistics, Testing and Defense Acquisition* recommended that, "The Department of Defense and the military services should give increased attention to their reliability, availability, and maintainability data collection and analysis procedures because deficiencies continue to be responsible for many of the current field problems and concerns about military readiness." (Recommendation 7.1, Page 105)

In response to this recommendation and other observations on the state of current practice in DoD compared to industry best practices, the Department asked the National Academies to host a workshop on reliability. The first workshop was held June 9-10, 2000, at the National Academy in Washington. Speakers and participants were from industry, academia, and the Department of Defense. The suggestions from the workshop will be part of an effort to implement the recommendation to produce a "… new battery of military handbooks containing a modern treatment of all pertinent topics in the fields of reliability and life testing…" (Recommendation 7.12, Page 126). DoD Handbook 5235.1-H, *Test and Evaluation of System Reliability, Availability, and Maintainability: A Primer* was last updated in 1982.

A second workshop on software-intensive systems will be held next year.

MAJOR REPORTS

In FY00 and to date in FY01, there have been 14 formal reports on the OT&E and LFT&E of weapons systems for submittal to Congress. These reports are bound separately and available on request as an annex to the classified version of this annual report.

This annual report responds to statutory requirements. No waivers were granted to subsection 2399 (e)(1), Title 10, United States Code, pursuant to subsection 2399 (e)(2). Members of my staff and I will be happy to provide additional information as appropriate.

Philip E. Coyle
Director

TABLE OF CONTENTS

PART I DOT&E ACTIVITY AND PROGRAM SUMMARY OVERSIGHT

PART II TEST RESOURCES AND RANGES

PART III ARMY PROGRAMS

PART IV NAVY PROGRAMS

PART V AIR FORCE PROGRAMS

DoD

HEALTH AFFAIRS

PART VII JOINT TEST AND EVALUATION (JT&E)

PART VIII NON-MAJOR SYSTEMS OT&E

PART IX LIVE FIRE TEST AND EVALUATION (LFT&E)

PART X CINC SUPPORT

PART XI YEAR 2000 (Y2K) OPERATIONAL EVALUATIONS

PART I

DOT&E ACTIVITY SUMMARY

AND PROGRAM OVERSIGHT

DOT&E ACTIVITY SUMMARY

DOT&E activity for FY00 involved oversight of 213 programs, including 26 major automated information systems. Oversight activity begins with the early acquisition milestones, continues through approval for full-rate production and, in some instances, during full production until deleted from the DOT&E oversight list.

Our review of test planning activities for FY00 included approval of 48 Test and Evaluation Master Plans (TEMPs), as well as 36 Operational Test Plans. Live Fire Test and Evaluation (LFT&E) activity included the approval of 11 LFT&E Strategies and Test Plans for inclusion in the TEMPs. In FY00 and to date in FY01, DOT&E prepared 14 reports for the Secretary of Defense and the Congress .

DOT&E also prepared and submitted numerous reports to DAB principals for consideration in DAB deliberations.

TEST AND EVALUATION MASTER PLANS APPROVED

Advanced Mission Computer and Displays (AMC&D)
AIM-9X Rev C
All Source Analysis System (ASAS) Rev K
AN/APR-39A (V) 2 Radar Signal Detecting Set Program Rev B
AN/SQQ-89f(V) Surface Ship
Army Tactical Missile System (ATACMS) Block II P3I BAT Program
Auxiliary Dry Cargo Carrier (T-ADC (X))
Blackhawk UH-60 Utility Helicopter
Bradley Fighting Vehicle System (BFVS) A3
M2A3/M3A3
Business Systems Modernization (BSM)
CEC Annex A for the E-2C Integration Program
Common Imagery Ground/Surfaces System
Cooperative Engagement Program (CEC) Rev 1
Crusader
CVNX
DDG51 Guided Missile Destroyer Program Rev 8
Defense Integrated Military Human Resources System (DIMHRS)
E-2C Mission Computer Upgrade (MCU)
Evolved SEASPARROW Missile
F/A-18E/F
F-15E Tactical Electronic Warfare System (TEWS) AN/ALQ-135 BAND 1.5
Force XXI Battle Command, Brigade and Below (FBCB2)
Global Combat Support System (GCSS) (CINC/JTF) Annex A
Integrated Defensive Electronic Countermeasures (IDECM) Block One
Joint Stars Change 1
Joint Stars RTIP
Land Attack Destroyer (DD 21) Rev A
LPD17 Amphibious Transport Dock Ship Rev B
M270A1 MLRS
MIDS F-15 Fighter Data Link (FDL)
MK 48 ADCAP Torpedo Rev 8
National Airspace System (NAS)
National Missile Defense (NMD)
Navy Theater Wide (NTW) TBMD Change
RAH-66 Comanche
Sense and Destroy Armor (SADARM)
Sensor Fuzed Weapon (SFW) 6/22/00 Rev
Stinger Block II Missile System
Submarine Exterior Communications Systems (SubECS) Capstone
Tactical UAV (TUAV)
THAAD
Theater Battle Management Core Systems (TBCMS)
Tomahawk Cruise Missile Change 5
Tube-Launched Optically -Tracked Wireguided Fire and Forget (TOW F&F) Missile
V-22 Osprey
Vertical Takeoff and Landing Tactical Unmanned Aerial Vehicle (VTUAV)
WC-130J

OPERATIONAL TEST PLANS APPROVED

Advanced Deployable System (ADS)
Advanced TOMAHAWK WCS (ATWCS) OPEVAL
AGM-154B Joint Standoff Weapon System (JSOW)
AIM-9X OT-IIA
All Source Analysis System (ASAS) Block II Remote Workstation (RWS) (Light) SEP
ALR-56M / ALE-47 OFP
AN/SQQ-89f(V) Surface ASW Combat System OT-IIIG
Army Tactical Missile System (ATACMS) Block II BAT EDP
ATACMS Block II BAT SEP
ATFLIR OT-IIA/B
C-130J QOT&E Phase 1A
Close Combat Tactical Trainer (CCTT) EDP
Cooperative Engagement Program (CEC)
DDG 51 Class Destroyer OT-IIID2
Defense Civilian Personnel Data System (DCPDS)
Defense Joint Accounting System
Defense Medical Logistics Standard Support (DMLSS) QOT&E
Defense Medical Logistics Standard Support (DMLSS) AIS CSW OT-IID
DoD Advanced Automation System (DAAS) / Digital Airport Surveillance System
Evolved SEASPARROW Missile OT-IIA
F-15E Tactical Electronic Warfare System (TEWS) AN/ALQ-135 BAND 1.5
Global Combat Support System (GCSS)
Integrated Defensive Electronic Countermeasures (IDECM) Block I OT-IIIA
JDAM OT-IIB Change 1
Joint Biological Point Detection System (JBPDS)
JPATS MOT&E
JSTARS Computer Replacement Program (CRP) DT/OT
Medium Altitude Endurance Unmanned Aerial Vehicle (Predator)
MIDS F/A-18 OT-II A-2
MIDS F-15 Fighter Data Link (FDL) QOT&E
MK 48 ADCAP Torpedo OT-IIIF
Prophet
Propulsion Replacement Program (PRP) IOT&E
Theater Battle Management Core Systems (TBCMS) MOT&E
Theater Battle Management Core Systems (TBCMS) MOT&E
U.S. Army Non-Stockpile Chemical Materiel Program

LFT&E STRATEGIES AND TEST PLANS APPROVED

Abrams Tank (M1A2)
Advanced Amphibious Assault Vehicle (AAAV)
Brilliant Antiarmor Submunition (BAT)
C-130 Avionics Modernization Program (AMP)
CH-47F LFT Propulsion System/Fuel Subsystem DTPs
Objective Individual Combat Weapon (OICW)
Line-of-Site Antitank Missile (LOSAT)
M829E3 120-MM APFSDS-T Cartridge
UH-60 Black Hawk Helicopter Modernization Program
Wolverine Heavy Assault Bridge Phase III
XM104 Wolverine Heavy Assault Bridge Change 2 – DTP

REPORTS TO CONGRESS FOR FY00 AND FY01 TO DATE

VCCS OT&E Report
(October 1999)

FDL OT&E Report
(October 1999)

Minuteman III OT&E Report
(December 1999)

RAM Block I Upgrade
OT&E/LFT&E Report
(January 2000)

SH-60B and HH-60H
LFT&E Report
(January 2000)

F/A-18E/F Hornet
OT&E/LFT&E Report
(March 2000)

SLAM-ER OT&E/LFT&E
Report
(May 2000)

JSTARS OT&E Report
(August 2000)

XM1001 40mm Canister
Cartridge LFT&E Report
(September 2000)

V-22 Osprey OT&E/LFT&E
Report
(November 2000)

F-15E TEWS AN/ALQ 135
Band 1.5 OT&E Report
(November 2000)

Coastal Mine Hunter
(MHC 51) OT&E Report
(December 2000)

MH-47E AND MH-60K
SOA LFT&E Report
(December 2000)

B-2 Bomber Conventional
Warfare Mission LFT&E
Report
(January 2001)

During this fiscal year the DOT&E and his staff assistants met with Service operational test agencies, program officials, private-sector organizations, and academia; monitored test activities; and provided information to the DAB committees as well as the DAB principals, the Secretary and Deputy Secretary of Defense, the USD(A&T), the Service Secretaries, and the Congress. Active on-site participation in and observation of tests and test-related activities remain among our most effective tools. In addition to on-site participation and local travel within the national capital region (NCR), the Director and his staff completed over 700 trips in support of operational and live fire test activities.

Security considerations preclude identifying Special Access Programs (SAP) in this report. However, DOT&E continues its involvement in SAPs. The objective is to ensure operational effectiveness and suitability do not suffer because of the extraordinary security constraints imposed on these programs.

DOT&E PROGRAM OVERSIGHT

This office is responsible for approving the adequacy of plans for operational test and evaluation and for reporting to the Secretary of Defense, USD(AT&L), Service Secretaries, and the Congress the operational test results for all major defense acquisition programs. For DOT&E oversight purposes, major defense acquisition programs were defined in the law to mean those programs meeting the criteria for reporting under section 2430, title 10, United States Code (Selected Acquisition Reports (SARs)). The law (sec.139(a)(2)(B)) also stipulates that the DOT&E may designate any other programs for the purpose of his oversight, review, and reporting. With the addition of such "non-major" programs, DOT&E was responsible for oversight of 213 acquisition programs during FY00.

Non-major programs are selected for DOT&E oversight after careful consideration of the relative importance of the individual program. In selecting non-SAR systems for oversight, consideration is given to one or more of the following essential elements:

- Congress or OSD agencies have expressed a high level of interest in the program.
- Congress has directed that DOT&E assess or report on the program as a condition for progress or production.
- The program requires joint or multi-Service testing (the law (sec. 139(b)(4)) requires the DOT&E to coordinate "testing conducted jointly by more than one military department or defense agency").
- The program exceeds or has the potential to exceed the dollar threshold definition of a major program according to DoD 5000.1, but does not appear on the current SAR list (e.g., highly classified systems).
- The program has a close relationship to or is a key component of a major program.
- The program is an existing system undergoing major modification.
- The program was previously a SAR program and OT is not yet complete.

This office is also responsible for the oversight of LFT&E programs, in accordance with 10 USC 139. DoD regulation uses the term "covered system" to include all categories of systems or programs identified in 10 USC 2366 as requiring live fire test and evaluation. In addition, systems or programs that do not have acquisition points referenced in 10 USC 2366, but otherwise meet the statutory criteria, are considered "covered systems" for the purpose of DOT&E oversight.

A covered system, for the purpose of oversight for LFT&E, has been determined by DOT&E to meet one or more of the following criteria:

- A major system within the meaning of that term in 10 USC 2302(5) that is:
    - user-occupied and designed to provide some degree of protection to the system or its occupants in combat; or
    - a conventional munitions program or missile program

- A conventional munitions program for which more than 1,000,000 rounds are planned to be acquired

- A modification to a covered system that is likely to affect significantly the survivability or lethality of such a system.

The DOT&E was responsible for the oversight of 90 LFT&E acquisition programs during FY00.

PROGRAMS UNDER DOT&E OVERSIGHT
FISCAL YEAR 2000

ARMY

ADDS/ELPRS
AFATDS (ATCCS)
ASAS (ATCCS)
ATACMS BLOCK II & IIA (BAT)
BATTLEFIELD DIGITIZATION
BLACKHAWK (UH-60L+)
BRADLEY FVS (M2M3) UPGRADE
C2 VEHICLE
CCTT
CH-47F CARGO HELO
CHEMICAL DEMILITARIZATION
COMANCHE (RAH-66)
CRUSADER
CSSCS (ATCCS)
FAADS C2I (ATCCS) (Includes GBS)
FBCB2
FMTV
TOW-FIRE & FORGET
FUTURE COMBAT VEHICLE
FUTURE SCOUT/ CAVALRY SYSTEM
HIMARS
JLENS
JAVELIN (JETI)
JCALS
JSTARS CGS
JTRS
KIOWA WARRIOR (OH-58D)
LAND WARRIOR
LONGBOW APACHE (AH-64D)
LONGBOW HELLFIRE
LOSAT
M1 BREACHER
M1 HAB
M1A2 UPGRADE
M829E3
MCS (ATCCS)
MH-47E/MH-60K SOA
MIDS-LVT (2)
MLRS (GUIDED ROCKET)
MLRS UPGRADE
NBC RECON VEHICLE
OCSWS
OICWS
PROPHET
RCAS
SADARM
SCAMP (MILSTAR, BLK II)
SIIRCM/ATIRCM/CMWS
SINCGARS
SIRFC
SMART-T
STINGER RMP
TC-AIMS II
TUAV
WIDE AREA MUNITION
WIN-T
XM 96 LFHG
XM 1001 40mm CANISTER CARTIDGE

NAVY

AAAV
ACDS BLK I
ADC (X)
AEW
AIEWS
AIM-9X UPGRADE
ALAM
ALR-67/ASR
AN/SPY-1 B/D (AEGIS)
AN/SQQ-89 (SQS-53/SQR-19)
APR-39 (ALL VERSIONS)
AV-8B REMANUFACTURE
CEC
CH-60 CSAR HELICOPTER
CH-60S FLEET CBT SPT HELICOPTER
HH-60H/SH-60B
CVN(X)
CVN-68 Class
DDG-51 (ALL VARIANTS)
DIMHRS
E-2C
EA-6B (ALL UPGRADES)
ESSM
F/A-18 E/F (UPGRADES)
F/A-18 E/F
FDS/ADS
IDECM
JCC(X)
JSOW BASELINE
JSOW BLU-108
JSOW UNITARY
LHD CLASS
LH(X)
LPD17 (LX)
MHC (COASTAL MINE HUNTER)
MIDS LVT (1)
MK-48 ADCAP (ALL MODS)
MMA
MUOS
NESP (EHF)
SSGN
SSN 774 VIRGINIA CLASS
NSIPS
QRCC/SSDS
RAM
DD-21
SEA SPARROW AIM/RIM-7
SH-60R
SLAM-ER+C138
SM-2 (BLKS III/IIIA&B)
SM-2 BLK IV/IVA
SSN21/BSY-2
SSN-23 JIMMY CARTER
STRATEGIC SEALIFT
SUB COMMS (SCSS)
T-45TS
T-AGOS/SURTASS/LFA
TAMPS
THEATRE MISSION PLANNING CENTER

TACTICAL TOMAHAWK
TRIDENT II MISSILE
UHF FOLLOW-ON SATELLITE
USMC H-1 UPGRADE
V-22
VTUAV
JMPS

AIR FORCE

ABL
ADVANCED EHF
AFMSS
ALR-56M
ALR-69 (ALL VERSIONS)
AMRAAM (AIM-120)
JAMSS
B-1B CMUP (ALL UPGRADES)
B-1B CMUP/JDAM
B-1B CMUP/COMPUTER UPGRADE
B-1B CMUP/DSUP
B-2
C-130J (ALL VARIANTS)
C-130 AMP
C-17A
C-17 UPGRADE
C-5 RERP
CIGSS
CSAR
CSEL
DCGS
DCPDS
E-3A AWACS
EELV
F-15/TEWS
F-22
GCSS-AF
GTN
HAEUAV (Global Hawk)
ILSS
IMDS
JASSM
JDAM
JOINT HELMET MOUNTED QUEING SYSTEM
JPALS
JPATS
JSTARS (E-8C)
MIDS-LVT3 (FDL)
MILSTAR
MINUTEMAN III GRP PHASE 1
MINUTEMAN III PRP
NAS
NAVSTAR GPS
PREDATOR
RSA
SBIRS
SFW
SFW P31
SWPS
TBMCS
TITAN IV
TRAC2ES
JSTARS (RTIP) (E-8D RADAR TECH INSERT PROG)
WIDEBAND GAPFILLER

BMDO

MEADS
NAVY AREA TBMD
NMD
NTW
PATRIOT PAC-3
SPACE BASED LASER
THAAD/GBR

DFAS

DJAS
DJMS
DPPS

DISA

DII/COE
DMS
GCCS/GCSS

DLA

BUSINESS SYSTEM MODERNIZATION (BSM)
FAS
SPS

DOD

CID
HDBTDC
HSRS
JOINT BIOLOGICAL POINT DETECTION SYSTEM
JOINT BIOLOGICAL REMOTE EARLY WARNING SYSTEM
JOINT SERVICE LIGHT NBC RECON SYSTEM
JOINT WARNING & REPORTING NETWORK
JOINT SERVICE LIGHTWEIGHT STANDOFF CHEMICAL AGENT DETECTOR
JOINT CHEMICAL AGENT DETECTOR
JSF
NPOESS
TCS

OSD

GBS
SMART CARD

OSD(HA)

CEIS
CHCS II
DMLSS
TMIP

PART II

TEST RESOURCES

AND RANGES

T&E RESOURCES: A CORPORATE APPROACH TO MANAGING FUTURE T&E RESOURCES

INTRODUCTION

After a decade of declining T&E resources and a deteriorating Major Range and Test Facility Base (MRTFB), the trend may be slowing. Over the last few years, Congress has been providing small increases over the requested amounts in the T&E funding lines as we have made a better case for support for T&E. I would like to thank the Congress for their support. Nonetheless, more needs to be done to compensate for the losses incurred during the previous decade and to close the significant gap that exists between T&E mission requirements and the T&E resources available to support the mission.

It is imperative that we maintain the viability of our major land, air, and sea test ranges as well as the unique, high-value ground test facilities. These test ranges and facilities are essential for testing systems for the foreseeable future. If ever lost to DoD use, these assets could not be recovered or replaced.

We continue to be concerned over DoD's ability to meet future T&E requirements. The following evidence points to the divergence between the workload and the resources needed to accomplish the workload:

- Resources supporting Operational T&E (OT&E) continue to decline while workload increases. Resources are insufficient to support early involvement of operational test personnel in acquisition programs or to adequately fund OT&E of minor acquisition programs.

- MRTFB operating and investment funding has been reduced each year since 1990. The annual funding is nearly $1 billion below the 1990 level, about a 30 percent reduction. The sum of the reductions over the decade totals $8 billion.

- The decline in T&E personnel at the MRTFB over the past 10 years continues unabated throughout our programming horizon. By 2001, T&E personnel will be down about 14,000, a 32 percent decrease, from the 1990 level. In addition, the number of military personnel in developmental and operational testing has declined dramatically. Army military personnel directly involved in developmental testing fell 99 percent from 1990 to 2001. Military personnel involved in Air Force development testing were reduced 39 percent in the same period. Between 1993 and 1999, the number of military personnel involved in operational testing decreased by 33 percent.

- The low rate of investment for T&E facilities continues to be a critical problem, especially in the category of military construction. From 1990 to 2001, overall investment in T&E was reduced by 28 percent, while the funding for military construction decreased by over 90 percent.

To compensate for years of decline in T&E resources, we must invest in more modern, efficient facilities that address new technologies, reduce operations cost, reduce the number of personnel required to perform the T&E mission, and accept the realities of constrained infrastructure resources—both personnel and funding. The current DoD T&E investment rates are well below those for comparable facilities in the private sector.

In order to comprehensively address needed T&E resources and mission requirements, we have initiated the development of a T&E corporate strategic plan. The Service Vice Chiefs and I are sponsoring the plan. It will evaluate T&E future needs in the light of Joint Vision 2020 and the serious shortfalls that already exist due to resource reductions over the past decade. The plan will identify resource requirements from a Department-wide perspective and provide guidance for the next 20 years. Periodic updates will address changes to the Department's T&E needs and priorities.

T&E is supporting acquisition reform

As part of the acquisition reform process, a new series of acquisition policies is being issued. DoD Directive 5000.1, "The Defense Acquisition System," includes T&E as an integral part of the acquisition process through application of "integrated test and evaluation." To shorten acquisition cycle times, it is critical to have earlier involvement of OT&E personnel to ensure timely identification of potential problems when there are alternative solutions available. In this way, T&E can help ensure the most cost effective weapons reach our combat forces.

- T&E programs will be integrated throughout the acquisition process to provide essential information to decision-makers at the earliest feasible time; to assess progress in system development; to determine attainment of technical performance parameters; and to determine whether systems are operationally effective, suitable, and survivable for intended use.
- T&E is to be conducted to facilitate learning, assess technical maturity, facilitate integration into fielded forces, and confirm performance and interoperability.
- T&E will be closely integrated with requirements definition, threat projections, technology development, and systems design and development, and it will support the operational user through assessments of a system's contributions to mission capabilities and their integration into the field forces.

The new directive will result in an increasing workload for the T&E community and infrastructure. Members of the T&E workforce must be highly skilled, adaptable, and flexible, as they will be involved much earlier in all phases of the acquisition process. In addition, the technical capabilities of our test centers must be modernized and capacities expanded to keep pace with the rapidly changing technologies and accelerated rates of weapon system modernization programs. The increase in evolutionary developments within an acquisition program will equate to multiple concurrent programs at various stages of maturity, each requiring separate T&E. Integrated T&E will include:

- Emphasis on early operational assessments
- Development of an evaluation strategy and a T&E Master Plan earlier in the program
- Assessing contractor modeling and simulation data during evaluation of contractor proposals
- Emphasis on operational realism during developmental T&E
- Early interaction of OTA and developmental T&E personnel to determine when and how to combine OT&E events and to share data

- Creation of integrated test teams
- Emphasis on defining interoperability requirements

OPERATIONAL TEST AGENCY RESOURCES

Requirements for Operational Test Agencies (OTAs) are increasing

The Service OTAs have experienced increasing demands on their dwindling workforces, as shown in Figure 1, partially because of the effort to introduce the OTAs into the acquisition programs earlier. Early involvement by the OTAs is recognized as a primary way of gaining operational insights into the system under development at a time when flexibility in the design approach still exists. It also allows the OTAs to build a knowledge base that will lead to an effective operational test program.

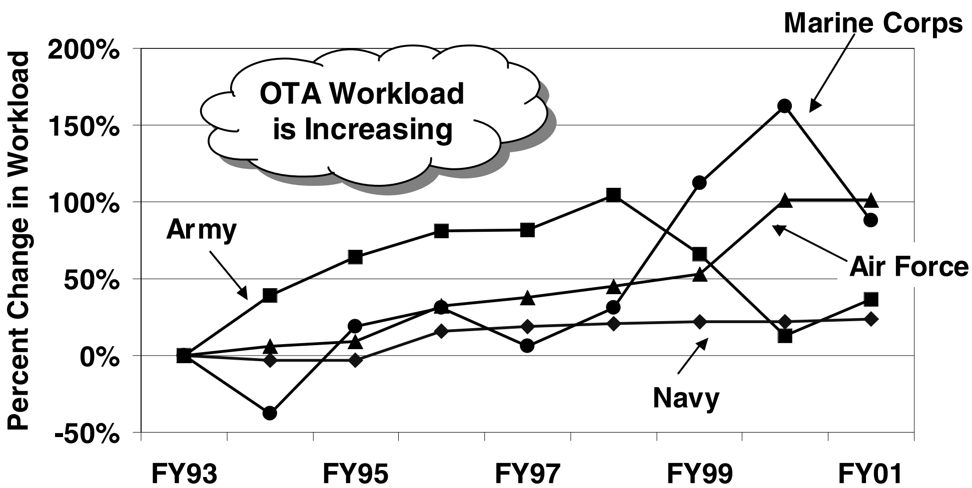


Figure 1. Operational Test Agency (OTA) workload is increasing

Shortfalls in funding constrain OT&E

The lack of resources available for OT&E has been limiting our ability to conduct OT&E for all required systems. This shortfall may result in (1) delay of acquisition programs, (2) diverting funds from other planned activities, (3) fielding of systems with increased risk or waivers of appropriate operational testing, or (4) delay of production until operational test is performed. All of the Operational Test Agencies are short of funding to comply with initiatives for earlier involvement.

Army OT&E funding has serious deficiencies, particularly with regard to the smaller acquisition programs. Some shortfalls were resolved during this past year's DoD programming reviews; however, there continues to be concern about the OT&E for smaller programs. There was a large funding shortfall for about 40 Acquisition Category II through IV programs during FY2000. Figure 1 indicates the Army OTA workload increasing by 13 percent between FY1993 and FY2000. A year ago, the Army was projecting an increase in FY2000 and FY2001, but, after a reduction in small test programs, the workload is now projected to show a decrease from the FY1999 level.

I am also concerned about the lack of funding for the Air Force OT&E Center (AFOTEC) to complete operational testing for the smaller acquisition programs. Air Force policy is that operational testing of these programs is to be funded from an AFOTEC Program Element. Significant shortfalls in FY2001 and FY2002 will affect Advanced Concept Technology Demonstration (ACTD) programs, Battle Laboratory Experiments, and Joint Experimentation programs. As many as 36 of the smaller programs, those in categories below Acquisition Category I, appear to be unfunded.

The Navy's approach to funding OT&E is different than the Army's and Air Force's. The Commander of the Navy's Operational Test and Evaluation Force (COMOPTEVFOR) receives funding from the acquisition programs to finance OT&E. This approach makes the OT&E funding the responsibility of the program under test. There remains insufficient funding budgeted to finance early involvement of Navy operational testers in developmental T&E programs.

The Marine Corps's OT&E funding is also a matter of concern since workload is increasing but funding has declined from the levels in the mid-1990s. The Marine Corps Operational Test and Evaluation Activity (MCOTEA) does not have adequate resources to support nuclear, chemical, and biological defense operational test requirements.

OTA manpower is a concern

The OTA workload is increasing, yet the government workforce in the OTAs, which peaked in FY1993, continues to decline. Civilian personnel declined by 45 percent and military personnel declined by 35 percent between FY1993 and FY2000, as shown in Figure 2. These reductions exceeded the corresponding decline in the total DoD civilian population and military force (27 percent and 19 percent, respectively) during that same period. While there has been an increase in contractor personnel who support the OTAs, the total reduction in the OTA workforce from FY1993 to FY2000 was 25 percent.

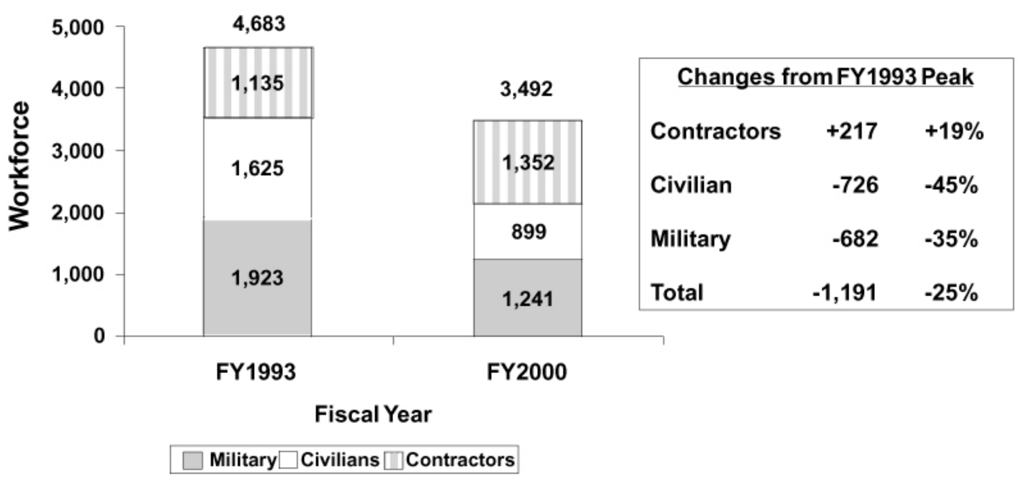


Figure 2. OTA workforce has declined

OTA workforce demographics are also a cause of concern. In FY 1999 more than half the civilian professionals were over age 50 and only 12 percent were under age 40. By the year 2004, 34 percent of those who fill GS-7 through GS-15 positions will be eligible for retirement. In addition, the number of OTA military personnel with tactical operations officer skills (the skills most useful in OT&E), and their percentage of the total workforce, has declined.

Examples of these disturbing trends in manpower can be found in each Service OTA:

- **Army**
  - Since the FY1993 peak, the Army OTA military workforce fell by 61 percent and civilian workforce by 50 percent. These shortfalls continue unabated.
  - Over that same period, the Army OTA workload increased by 13 percent.
  - In FY2000, it became clear that funding shortfalls would preclude support for approximately 40 initial operational tests.
- **Navy**
  - The Navy OTA workload is the highest in its 55-year history.
  - The Navy civilian government workforce has declined by 23 percent since FY1993.
- **Marine Corps**
  - The Marine Corps has allocated its manpower away from T&E to its combat units.
  - The Marine Corps OTA workload is increasing, while the workforce is decreasing.
  - Operational tests for major information systems will have to be prioritized so that the available resources can be appropriately committed, leading to increased risk for the remaining, lower-priority programs.
  - Resources are insufficient to satisfy the requirements for some nuclear/chemical/biological operational testing.
  - The Marine Corps OTA is now analyzing its need for additional workforce.
- **Air Force**
  - Between FY1993 and FY2000, the Air Force operational testing workload has increased by 100 percent.
  - This increase is the direct result of the assignment of all Air Force acquisition programs to the Air Force Operational Test and Evaluation Center for OT&E.
  - This workload growth is anticipated to continue until FY2005. In the meantime, manpower will increase only modestly, severely limiting the number of programs that operational testers will be able to support.

Adequate manning and funding at the OTAs is imperative, particularly if the acquisition process is to benefit from operational perspectives when changes in design, tactics, or doctrine are most easily accomplished. I intend to continue to do all I can to address the manpower and funding shortfalls at each OTA and to ensure that operational testers are involved early.

MAJOR RANGE AND TEST FACILITY BASE RESOURCES

In the past, I reported that operating and investment funding and personnel for the MRTFB had been reduced dramatically, while T&E workload had remained steady. Since 1988, at least 18 studies have focused on reducing the T&E infrastructure, although T&E infrastructure accounts for less than 2 percent of the approximately $100 billion spent by the Department on infrastructure overall. Between

1990 and 2001, the T&E workforce at major T&E centers is expected to reflect a reduction of 14,000 positions. I have argued against continued reductions because the T&E community's ability to test new weapons systems has not kept pace with the increasingly sophisticated technologies integrated into those weapons.

The complexity and interdependence of today's DoD weapons systems dictate that T&E capabilities support the development and acquisition process. A recent Defense Science Board (DSB) study concluded that full integration of the entire T&E cycle is essential. Critical knowledge is gained from testing at each stage in the cycle, from early development through operational T&E. If a phase is slighted through lack of adequate testing, a delay in testing, or a test limitation due to lack of capability within the T&E infrastructure, the acquisition program will suffer.

Unfortunately, past studies of T&E resources have often focused on optimizing capacity, instead of on identifying the best ways to support the acquisition process, such as reducing the cycle time for weapons programs. The cost of having reserve capacity is small compared to the cost of not having the capacity when needed. Also, reduced procurement programs do not change this need, since the T&E capabilities are needed, regardless of whether DoD is buying 10 or 1,000 of a particular weapon system. The DSB Task Force on T&E reached the following conclusion in its September 1999 report: "The focus of T&E should be on optimizing support to the development/acquisition process, not on minimizing (or even 'optimizing') T&E capacity. T&E is an integral part of system design, development, and acquisition."

To adequately support the acquisition process, T&E personnel must be involved early in programs; efficient and effective test processes must be in place; and the right test facilities and capabilities, in good working order, must be available when needed. Problems uncovered late in the acquisition cycle are often more expensive to correct and if not corrected may make deployed systems less effective than expected. It is imperative that T&E facilities be modern and capable of measuring data on system performance, operational effectiveness, suitability, and survivability. In his June 2000 report, *The Road Ahead*, the Under Secretary of Defense (Acquisition, Technology, and Logistics) highlighted the need for early involvement of T&E: "An integrated use of the time-phased requirements, more mature technology, evolutionary acquisition, and the early use of test and evaluation for discovery can result in reduced cycle times so that the warfighter will get delivery of required systems sooner and in planned increasing increments of capability to meet the evolving threat."

As in any business, improved T&E productivity requires some new investment. Since 1990, test investment budgets have been reduced about 35 percent. Not only have we been hard-pressed to finance the investments necessary to implement consolidation, but also we have been limited in our ability to field advanced test capabilities to match the rapidly advancing capabilities of new weapon systems. We have not made sufficient investments to reduce turn-around times at all of our T&E facilities or replace older, high-maintenance, and workforce-intensive facilities or equipment.

In summary, the Department has struggled to maintain the T&E infrastructure, while continuing to provide high-quality support despite the decline in available resources. The deep reductions in personnel and funding have brought us to a point where increased efficiencies can not be accomplished without new investment. The downward spiral of test resources must be reversed if we are to adequately test the weapon systems that our soldiers, sailors, airmen, and marines will need in the 21st century,

Development testing workload is robust

Despite reductions in the overall T&E workforce, the workload at the MRTFB has remained relatively stable in recent years. Beginning in 1990, test workload was expected to decline. Based on this forecast, MRTFB operating and investment funding were dramatically reduced throughout the 1990s. The expected decline in workload did not occur, and in fact, over these years, some facilities operated at record workload levels causing a large divergence between the size of the T&E workload and workforce.

Not only is the overall level of workload at our test ranges and centers demanding, but the fluctuation of workload at the various test facilities is challenging, from both workforce and management standpoints. For example, Figure 3 depicts the open-air range workload at the Naval Air Warfare Center (NAWC)-Aircraft Division at Patuxent River, Maryland, over the last 10 years. The open-air range workload has increased slightly overall. The year-to-year fluctuations, however, are large, which illustrates that test capability should not be sized for a low year or even for the overall average. The capacity has to be at a level that supports the acquisition programs when the support is needed. The large acquisition programs, with their high test workload and significant daily costs, cannot afford to wait for access to the test ranges and centers.

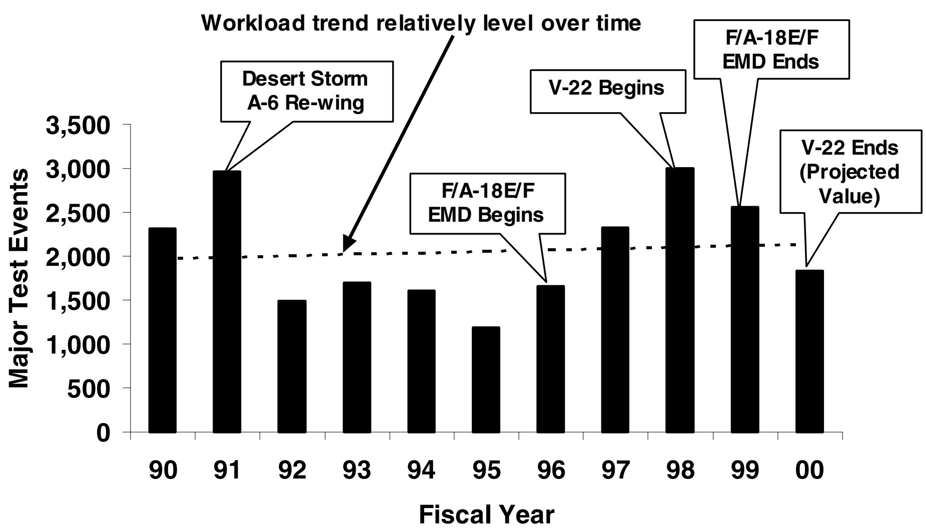


Figure 3 Workload fluctuates at open-air range, NAWC-Aircraft Division, Patuxent River

The Arnold Engineering Development Center (AEDC) in Tullahoma, Tennessee, is another example. During FY2000, the center's engine test facilities generated one of the highest workload levels ever experienced; but the FY2001 workload projections are approximately 15 percent lower. On the other hand, AEDC's wind tunnel workload was low in FY2000 but projected to increase by 10 percent during FY2001.

In addition to workload fluctuation, there are indications of workload increases at specific ranges and facilities. For example, with increased Navy Theater Ballistic Missile Defense Program testing at the Pacific Missile Range Facility (PMRF) at Barking Sands, Hawaii, the test and training workload is projected to increase by five times by the year 2004. Figure 4 illustrates this projected increase in workload for the next 10 years.

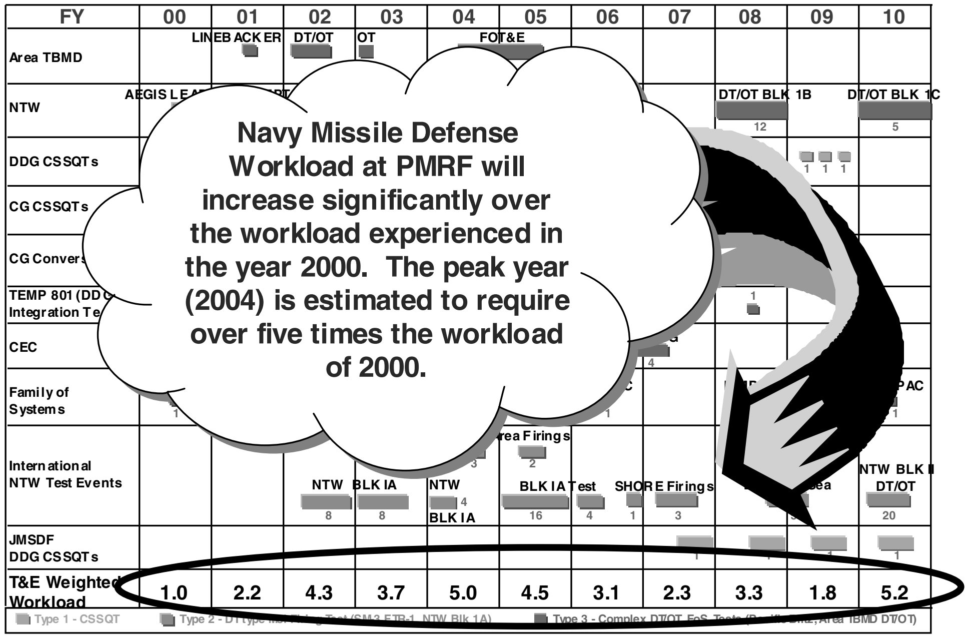


Figure 4. Navy Theater Missile Defense Workload at PMRF will experience a major increase

Declines in T&E resources are leveling off

In the early 1990s, T&E funding was reduced every year. However, in each of the last 6 years, as we have better articulated our needs, Congress has increased T&E funding. We are thankful for this congressional support, but the level of increase is still small compared to the decreases of the 1990s and does not compensate for the losses incurred. Overall, the T&E community still lacks the level of funding necessary to maintain current capabilities, let alone provide adequate future capabilities.

Figure 5 illustrates the leveling-out of RDT&E funding for T&E operations and investment. The decline in funding from FY1990 to FY1999 was 31 percent. Since then the funding level has fluctuated around a level that is approximately 29 percent below the FY1990 level.

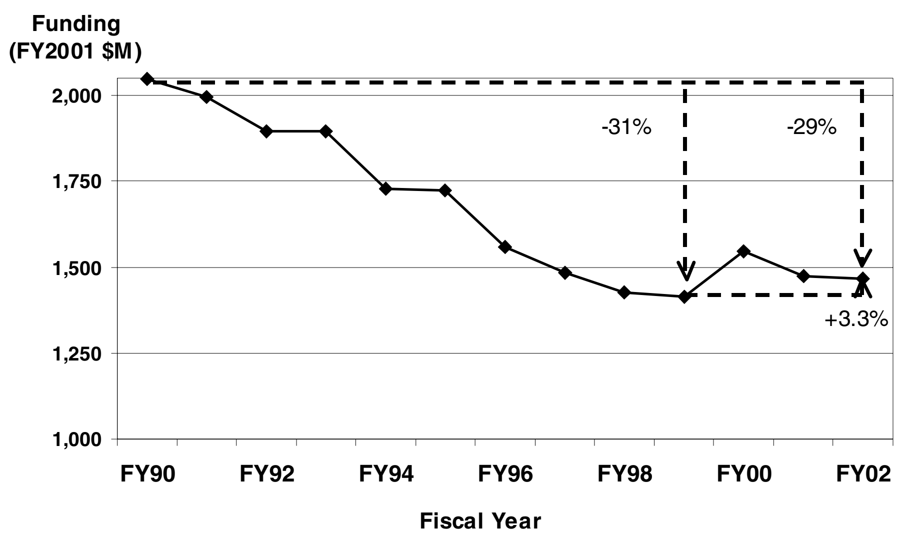


Figure 5. RDT&E funding for T&E operations and investment is stabilizing

Within the DoD, there are several categories of resources that have in the past 2 years either increased or remained the same. Funding for targets and threat simulation developments has remained relatively constant while improvement and modernization funding has increased. Institutional operating funds have also increased slightly. While these increases are dwarfed by the declines from FY1990 to FY1998, they are a welcome relief.

Nonetheless, one category that continues to decline is the workforce. In particular, the decline in military T&E personnel continues unabated and is a cause for serious concern. My office will continue to monitor this situation and make every effort to stop this trend.

Facilities are declining

In recent annual reports, I highlighted the deplorable status of facilities located within the MRTFB. I repeatedly stated that the test infrastructure is aging and our data now shows that over 75 percent of the MRTFB facilities are older than 30 years. Within the T&E community, we recognize the need to improve and modernize our facilities, while keeping them operational in order to provide the needed support to the acquisition programs. Unfortunately, we have had to choose which avenue to pursue. To continue to support required testing, we have had to keep our facilities operational. As a result, we have been unable to improve and modernize those facilities as we watched the backlog of maintenance and repair increase. The current low levels of investment funding have able to maintain the efficiency and productivity of only selected areas of the current T&E infrastructure. Additional funding is necessary to maintain the aging infrastructure and to provide those new capabilities needed to test the DoD systems of the future.

Partnerships and alliances are providing new opportunities for T&E

Partnerships and alliances formed with industry and other government agencies will lead to improved testing as well as cost savings for the taxpayer. While the T&E community, including the MRTFB, has participated in such activities for some time, we are beginning to see an increase in the number of such relationships and their scope. By forming partnerships and alliances with others, the test centers are able to pursue innovative approaches to problem solving, leading to better service for both old and new customers, and more effective use of existing facilities. Specific examples include:

- ***NASA/DoD Alliances:*** The DoD has had working relationships with NASA for many years and these have evolved into more formal alliances. A series of joint studies in the 1990s on improving the management and maintenance of various aeronautical and space facilities resulted in six formal alliances between the DoD and NASA that focus on better coordination and joint planning activities. This year, the DoD and NASA chartered a broader National Aeronautical Test Alliance to provide integrated strategic management of and planning for aerodynamic, aerothermal, and aeropropulsion facilities of both agencies.

- ***Chesapeake Regional Ranges Cooperative:*** The purpose of this alliance is to create testing and training opportunities that no one partner could support, fund, or build for a single use. The members of the Cooperative are: Aberdeen Test Center; Maryland National Guard; Fort A. P. Hill; Commander in Chief, Atlantic Fleet in Norfolk; Naval Air Warfare Center-Aircraft Division at Patuxent River; NASA Wallops Island; and the Naval Surface Warfare Center Division at Dam Neck, Virginia.

- ***Aberdeen Test Center (ATC)/Battelle Partnership:*** ATC has formed a partnership with Battelle Memorial Institute, Columbus, Ohio, to test the safety of fireworks. ATC's expertise with explosives will help Battelle understand the conditions that exist when fireworks are stored in large quantities in warehouses or other facilities.

- ***Arnold Engineering Development Center (AEDC)/Loral Partnership:*** The large space chamber at AEDC had been idle for a decade. Loral wanted to use the facility to test, but the chamber and its instrumentation needed to be updated. After 4 years of negotiation, AEDC and Loral agreed to a 10-year partnership beneficial to each party. Loral contributed $1.5 million in new instrumentation to create a state-of-the-art space chamber at AEDC and AEDC will provide Loral with testing services that are beyond Loral's in-house testing capability. Loral will receive the testing at a reduced rate for the first four satellites tested at AEDC, after which they will be charged the normal AEDC commercial customer rates.

- ***Boeing/Air Force Partnership:*** A partnership between The Boeing Company and the Air Force is being executed at the Radar Cross Section (RCS) measurement ranges at Holloman Air Force Base, New Mexico. Under this agreement, Boeing provided the Air Force site with a test pylon and other equipment worth $5 million. In return, the Air Force will perform RCS testing for Boeing using both the Boeing equipment and the Air Force facility. Boeing will reimburse the Air Force for the direct cost plus any military pay associated with the testing. As a result, Holloman has a new customer with substantial test work and Boeing was able to close a costly test facility in California.

T&E INVESTMENTS

Investment funding is the key to maintaining existing T&E capability and to developing future T&E capability. Clearly, recent levels of funding have not kept pace with T&E needs. In some cases, limited modernization funding only supports expedient fixes and add-ons that do not capture the full capabilities and efficiencies of modern technology. There is significant risk associated with restricting investment to this level of funding. Acquisition decisions can be delayed or based on incomplete or inaccurate T&E results and could lead to the premature acquisition of less effective systems. Our future investment program will be to use the DoD T&E Enterprise strategic plan and its associated action plans and investment roadmaps. Our planning will also include those investments in T&E facilities and capabilities made by other program elements, such as acquisition programs (at contractor and government facilities), science and technology (S&T) programs, military construction, or programs of other DoD agencies.

Investment funds are declining as the need increases

During the 1990s, the resources to modernize T&E infrastructure were substantially reduced (see Figure 6). These declines occurred in conjunction with reductions in operations and maintenance funding and the T&E workforce. The Military Construction (MILCON) appropriation funds new facilities and major facility upgrades for T&E. In recent years, this funding has also been seriously reduced, as has funding for targets and threat simulators. The level of funding for improvement and modernization (I&M) is a small fraction of the level of funding that would be invested by private industry.

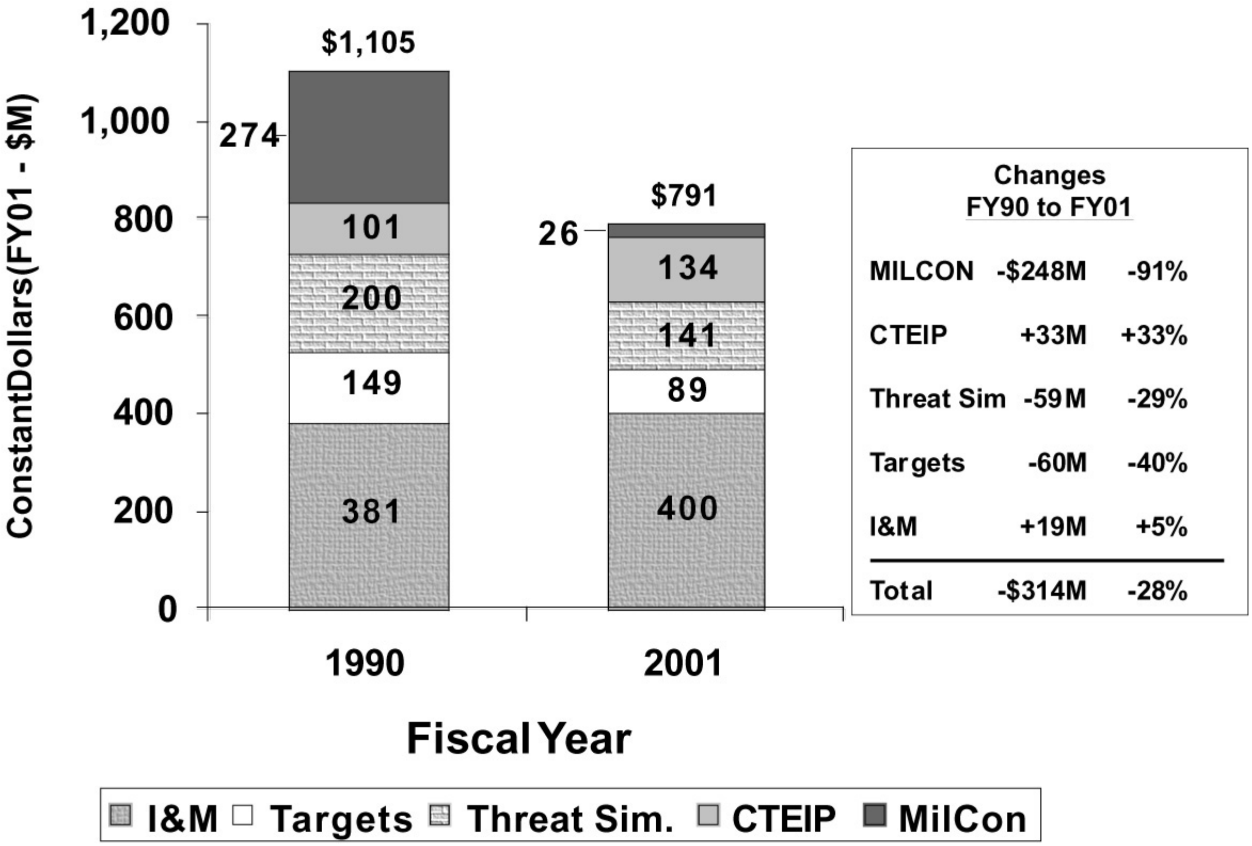


Figure 6. Total T&E Investment Funding has declined

It is increasingly difficult for the present T&E infrastructure to support testing of future needs (i.e., high-performance, high-technology-content weapon systems). Technology such as directed energy, precision guidance and control, "brilliant" weapons, data and signal processing capabilities, multi-spectral sensors, stealth, and information warfare challenge our current measurement capabilities; even more advanced technologies are under development in the laboratories or are being incorporated into emerging systems and weapon system upgrades. Our physical infrastructure averages over 40 years of age—far older than the physical infrastructure of comparable high-technology industrial concerns—and is inefficient and increasingly obsolete in significant technical areas. Efforts to respond to Joint Visions 2010 and 2020 will yield new systems and new concepts for warfighting. These systems and concepts must be tested to validate designs, to identify problems while they can still be remedied relatively inexpensively, and to determine military utility, suitability, lethality, and vulnerability. Not only must we test these systems and concepts on a schedule responsive to the needs of the acquisition community and the warfighters, but we must also modernize our T&E infrastructure if we are going to provide adequate T&E support.

Current investments are being made in T&E capabilities

The four sources of T&E investments are:

- ***Service and Defense Agency Investment and Modernization (I&M) Programs***. These programs provide modernization of existing capabilities and acquisition of new capabilities to meet the needs of the individual Service or Defense Agency.

- ***Central Test and Evaluation Investment Program (CTEIP).*** CTEIP provides a corporate investment approach to T&E needs, leverages Service and Defense Agency test investments, and funds those joint needs that would be considered beyond the scope of a single Service or Defense Agency. Individual CTEIP investment projects are executed and implemented by the Services and Defense Agencies.

- ***Military Construction Programs.*** These appropriations provide most major T&E capability, excluding instrumentation and minor construction.

- ***Acquisition Programs.*** Unique investments, at either contractor facilities or at government test centers, to support a specific acquisition program are planned and budgeted through the individual program.

Funding for Service investment and modernization (I&M) programs decreasing

Each Military Service pursues an I&M program focused on their test facilities in areas that have limited tri-Service use or interest. The funding for Service I&M projects has been declining at a time when additional investments are needed for new technologies. Service I&M requirements have had a difficult time competing with other critical needs in the Service budget processes. Between the FY1990 and the FY2001 President's Budgets, the total Service I&M funding decreased over $35 million (about 9 percent). This decrease was offset by congressional funding increases during the FY2001 appropriations process with the resulting appropriation being 5 percent above the FY1990 level.

As mentioned, each Service has I&M funding to apply to its test infrastructure. Projects within each Service compete for funding from this limited amount. In most cases, there are so many critical projects to improve *existing* test capabilities, that funding is not available for *new* capabilities. Selected I&M projects for each T&E center are discussed in the range summaries at the end of this section. Some of the most cost-effective Service I&M projects include the following:

- ***Kwajalein Missile Range (KMR) Modernization and Remoting Project.*** This project is a major modernization effort that includes updating four KMR radars and providing remote operations and diagnostics for Roi-Namur back to Kwajalein. At the completion of the project in FY2003, technical staff will be reduced by 20 percent from 520 to 417 persons. The radar modernization will result in a 70 percent reduction in lines of software code and an 80 percent reduction in custom hardware. The remoting will result in a 90 percent reduction in the need for inter-island commuting. In addition, this effort will reduce operating costs by over $17 million per year. The future savings from this project have been removed from the future years' budgets, so it is imperative that the project schedule remains on course.

- ***Network Centric Warfare (NCW) Project.*** The Navy initiated the NCW project to improve the network of RDT&E facilities required to support the development and testing of NCW-based systems such as E-2C Cooperative Engagement Capability and Joint Strike Fighter. The project will provide voice, video, and high-level architecture interface for T&E open-air ranges and simulation resources and for Navy laboratories. The NCW project will link nine T&E facilities in FY2001. Upon completion, this project will lower acquisition program technical risk by providing an environment for developing and testing system-of-systems interoperability requirements.

- ***Propulsion Wind Tunnel Upgrades.*** Using Air Force funding, Arnold Engineering Development Center (AEDC) has embarked on an aggressive upgrade and modernization project to improve test capabilities and minimize future failures at its aging facilities. AEDC's project will install advanced data acquisition and processing systems in both the 16-foot transonic wind tunnel and the 16-foot supersonic wind tunnel. In addition, this multiyear project will upgrade the two 60,000-horsepower electric starting motors and install flow-quality improvements in these unique 45-year old national assets. These improvements will result in a 60 percent reduction in the cost per data point, a 90 percent reduction in test installation time, and a 30 percent reduction in lost test time.

CTEIP projects cover array of new test capabilities

CTEIP was created to improve the management of the Department's T&E infrastructure and has received strong support from the Congress. This corporate investment program has yielded important benefits: testing resources are allocated on the basis of DoD-wide rather than Service-level benefit; specific areas of commonality such as interconnectivity, interoperability, or improved telemetry techniques are emphasized for common solutions; and unwarranted duplication is minimized.

To carry out its objectives, the management of the CTEIP closely coordinates its activities, including selection of specific projects for funding, with the Services' T&E investment planning activities and the Department's Planning, Programming and Budgeting System. Individual CTEIP investment projects are assigned to a lead Service or Defense Agency for execution and implementation. The three CTEIP categories of projects are: *Joint Improvement and Modernization (JIM)* projects to provide critically needed joint or multi-service test capabilities to test increasingly complex and sophisticated weapon systems; *Test Technology Development and Demonstration (TTD&D)* projects to facilitate the transition of mature technologies from the laboratory environment into T&E facilities; and *Resource Enhancement Project (REP)* subprojects for quick-reaction, near-term solutions to test shortfalls in support of ongoing operational test programs. REP funding is appropriate when the timeframe from definition of need through critical test dates does not allow sufficient time in the budget cycle to fund the required capability. REP subprojects are proposed by the Operational Test Agencies of the Services and Defense Agencies.

The following are examples of new test capabilities being developed by CTEIP:

- ***Advanced Range Telemetry (ARTM).*** The ARTM project is developing instrumentation to increase the efficiency, reliability, utility, and availability of the aeronautical telemetry RF spectrum through improvements in bandwidth efficient modulation, multipath mitigation, channel management, data compression, and improved antennas. The project is leveraging advances in the commercial telecommunications industry for adaptation into test telemetry that can be implemented at MRTFB, and will provide improved commonality, interoperability, and standardization across the MRTFB.

- ***Airborne Separation Video (ASV).*** The ASV project developed ruggedized ultra high-speed/resolution digital cameras for use in airborne and ground-based optical coverage of weapon system testing. These capabilities provide enhancements such as high resolution, full color capability, and in-flight data review to the current systems. ASV eliminates the need for film processing for many applications, resulting in substantial savings in manpower and dollars while providing the associated environmental benefits. Cameras are being used in support of F-22, F-16, and F/A-18C/D and E/F test programs.

- ***Transportable Range Augmentation And Control System (TRACS).*** The TRACS project is developing a self-contained suite of transportable equipment and instrumentation to provide common range control functions. The system can both augment existing range capabilities or provide standalone capabilities such as autonomous test command, control, data collection and analysis, and display. TRACS first deployment is to the Pacific Missile Range Facility to support Ballistic Missile Defense Organization (BMDO) theater missile defense testing.

- ***Shallow Water ASW Target (SWAT)***. The SWAT project will modify the USS *Dolphin* (AGSS 555), an existing, manned U.S. Navy diesel-electric research submarine for use as an ASW target. The *Dolphin* will be equipped with a 6-inch Acoustic Countermeasure Launch System, a mooring system to permit stationary bottom sitting, and upgraded shielding to permit testing with the next generation of torpedoes. In this configuration, the *Dolphin* will serve as a representative diesel-electric target. Target strength models of the *Dolphin* will be developed and validated to assist in the planning and evaluation of future developmental test and operational test events. At a minimum, SWAT will support the operational testing of Mk 54 Mod 0 Torpedo, Mk 48 ADCAP Torpedo, and SH-60R/ALFS programs.

Military Construction funding must increase

DoD's Military Construction (MILCON) appropriations, excluding family housing and homeowner assistance, totaled $3.31 billion and $2.97 billion in FY2000 and FY2001, respectively. Of that amount, only $65.4 million and $24.4 million; less than two percent of the FY2000 MILCON appropriations and less than one percent of the FY2001 MILCON appropriations, were appropriated for MRTFB T&E facilities in those years. We must find a way to increase MILCON funding if we are going to continue to provide the required testing and test support to the warfighter. Additional degradation in our test facilities and capabilities will lead to second-rate T&E facilities and second rate testing for our important acquisition programs.

Acquisition programs fund some T&E needs

Normally, generic T&E capabilities should be funded so they are located at the major MRTFB test centers. However, there are circumstances when a particular acquisition program requires a non-generic, unique test capability. As demonstrated in the following examples, the acquisition program must then define its unique requirement and fund the needed test capability.

- ***Underwater Explosions Test Facility***: This facility was constructed at Aberdeen Test Center (ATC) by the Navy's Seawolf program manager to support the Seawolf developmental test program because of the expense and difficulty of performing shock testing in the open sea due to environmental concerns. This facility has been used by other Navy programs for shock testing of components of the Virginia Class Submarine and for operational test and dock trials of the Navy's Advanced SEAL Delivery System, a manned submersible.

- ***Target Complex Upgrade***: The Brilliant Anti-Armor Submunition (BAT) program manager provided approximately $1 million to upgrade the fiber-optic communications data network and $200,000 for road widening at a White Sands Missile Range, New Mexico, test facility to aid in completing TACMS/BAT flight test missions, as well as captive flight and drop tests of the BAT submunition.

- ***Accelerated Corrosion Complex:*** The Family of Medium Tactical Vehicles (FMTV) program manager funded the development of the Accelerated Corrosion Complex at ATC to help predict the potential for corrosion on future combat vehicles. This facility provides aggressive, controlled exposure of land systems to corrosive conditions to hasten their weathering process and determine their susceptibility to corrosion. The facility includes a series of components for individual corrosive environments including a mist booth; splash trough; grit trough; humidity booth; and facilities and equipment to provide identification, analysis, and documentation of corrosion. In addition to supporting tests for the Army's FMTV, the facility has also been used to test the Marine Corps Medium Tactical Vehicle Remanufacture (MTVR) truck program.

Additional T&E investments are needed

Increased modernization funding is needed to provide test capabilities, test processes, and more realistic test environments for future weapon systems T&E. Areas that must be improved include:

- Ballistic missile interceptor/target position location and telemetry instrumentation
- A space test range to safely and adequately test space systems involving self-defense concepts, directed energy systems, active on-orbit multi-participant test scenarios, and survivability
- Expanded ground test capabilities for air and space systems and components
- Improved stealth test capabilities
- Improved interoperability testing of systems-of-systems among services
- Improved hypersonic systems testing
- Improved propulsion systems testing
- Improved threat representations of hostile forces
- More realistic environments for testing chemical/biological systems, including physical areas, countermeasures and simulants for live agents
- Inter-range commonality for data acquisition, and command and control
- Integrated test and training modeling and simulation
- Expanded use of distributed simulation
- Use of embedded test and training instrumentation

Assessing the requirements for future T&E resources is relatively straightforward when considering near-term systems. That is not so for advanced concepts with underlying or enabling technologies still in the research phase. Some advanced systems will require incremental improvements to existing test resources and methods, while others will require major improvements to existing capability. Still others—well beyond the scope of current systems in complexity and capability—will likely require T&E resources that simply do not exist and cannot be clearly identified at this time.

T&E must invest to support the strategies and goals of Joint Vision 2020

Joint Vision 2010 provided a template for the evolution of our joint operational forces and the conduct of joint operations through the development of four "operational concepts"—precision engagement, dominant maneuver, focused logistics, and full dimension protection. These concepts, enhanced by the attainment of *information superiority,* an essential precursor to achieving *decision superiority,* will enable U.S. dominance in the full spectrum of military operations (air, land, sea, and space). Joint Vision 2020 reaffirms the Joint Vision 2010 operational concepts and emphasizes the need for *jointness* in every facet of U.S. warfighting.

Making these concepts a reality requires technological advances across a broad spectrum of systems and capabilities. Effective and timely development of the necessary systems will, to a large extent, be dependent on our ability to test these new or enhanced systems and their enabling technologies.

New test technologies require a long lead-time for development, as well as obtaining the necessary acquisition support in the budget process. In light of the substantial reductions sustained by our T&E infrastructure over the past decade, and considering this long lead-time, it is imperative that investment in T&E resources be increased in anticipation of significant requirements predicted by the Joint Visions 2010 and 2020.

T&E must invest to prevent Frequency Spectrum Encroachment from limiting testing

Of major concern to the open-air test ranges is the shrinkage of the frequency spectrum available for use in testing. The radio frequency (RF) spectrum is important to T&E as it supports the large volume of telemetry, communications, and command and control needed for almost all test programs. In fact, the test and training communities are the predominant users of Government spectrum within the U.S. However, as demand for frequency spectrum is rising, spectrum availability is declining. Technology advances in weapon systems cause increased demand for RF spectrum for testing and training purposes, just as technology advances in the private electronic sector create demand for more spectrum to service the personal communications, electronic commerce, and entertainment industries. As most of the desirable spectrum is currently occupied, significant expansion is not feasible, and available spectrum continues to be in demand.

Since 1992, we have lost access to over 275 megahertz of the shared or dedicated radio frequency spectrum. At the same time, the data rates needed by test programs, which directly affect spectrum usage, have continued to increase. For example, in the 1970s, testing the F-15 required telemetry instrumentation capable of data rates of only 100 Kbits. Adequate testing of the F/A-18E/F now requires the transmission of data at rates of 10 Mbits, an increase in data of almost 100 times. The potential consequences of decreased access to this scarce resource include schedule delays and elimination of key tests. Reallocation of the frequency spectrum will require a number of DoD open-air test ranges to migrate users from one frequency band to another. This change increases costs to the ranges and the range users, and, in some cases, will stretch out test schedules. Numerous programs will be affected including aircraft and missile acquisition programs such as the Joint Strike Fighter, F/A-18E/F, and F-22.

Much of the technology needed by the test and training communities to meet spectrum demand can be derived or directly obtained from commercial technology. However, there are a number of physical and operational characteristics of weapons, weapons testing, and training that are substantially different from commercial applications. New technology programs under development may allow more data to be put through a given amount of frequency spectrum. One CTEIP initiative aims to develop technology that will double the data-carrying capacity of our telemetry bands. A second project will provide similar efficiencies for our target control, scoring, and test support data links, while a third will provide an antenna to allow small test articles to operate in a number of frequency bands simultaneously. We are also developing a wide-band data recorder that will provide increased flexibility in on-board storage and selective playback of data, thereby improving the efficiency of bandwidth management.

We will continue to make decisions that will provide the most efficient use of the dedicated T&E frequency spectrum, but the demand for spectrum capacity will continue to increase. The DoD's only alternative is to use currently available spectrum as effectively as possible. This can only be accomplished through continued investment in the development and deployment of suitable, more spectrally efficient systems.

T&E needs science and technology projects to stay abreast of weapons requirements

Advances in weapons technology may soon result in new high technology systems that cannot be adequately tested within the current test infrastructure. To expedite the transition of new technologies from the laboratory environment to the T&E capabilities and to guarantee that T&E ensures the readiness of weapons systems, it is essential that a T&E science and technology program be initiated.

Currently, research into and development of technologies to advance our test capabilities are seriously underfunded. We anticipate that an effective T&E science and technology program would require sustained funding of approximately $30 million per year. A focused T&E science and technology program must be put into place soon to meet these requirements.

CORPORATE MANAGEMENT OF T&E RESOURCES

While there is need for additional funding to improvement of current test capabilities and provide advanced test capabilities for future systems, there remains opportunities to improve the management of the existing resources. A number of actions are underway to improve the Department's corporate management of the T&E resources.

DoD T&E responsibilities have been realigned

On June 7, 1999, the Secretary of Defense approved realignment of T&E responsibilities within the Office of the Secretary of Defense. Key T&E functions were transferred to me from the Under Secretary of Defense (Acquisition, Technology, and Logistics) to strengthen my role in supporting "serious testing and evaluation with a view toward operations early in the life cycle of a program." I now have oversight of:

- The DoD T&E investment strategies, business process policies, and infrastructure, including those in the MRTFB
- The Central Test and Evaluation Investment Program (CTEIP)
- The Joint Technical Coordinating Group for Munitions Effectiveness
- The Joint Technical Coordinating Group on Aircraft Survivability
- The Threat Systems Office (TSO)
- The Precision Guided Weapons Countermeasures Test Directorate, now called the Center for Countermeasures

In conjunction with the above, I am responsible for:

- Managing the joint T&E investments under the CTEIP program and
- Reviewing each DoD component's budget submissions to determine funding adequacy for test investments, range and facilities recapitalization, and other T&E resources, as well as the adequacy of funding for Live Fire T&E and OT&E

DOT&E is participating in the Planning, Programming and Budgeting System

My office has a new responsibility as a member of the DoD Program Review Group (PRG). In this new role, we have the opportunity to increase DOT&E participation in the corporate management and decision making regarding the Department's resource allocation. The PRG examines potential issues in the Military Department and Defense Agency Program Objective Memorandums. Any issue that cannot be resolved by the PRG is referred to the Defense Resources Board (DRB), which is the senior DoD resource review board. The DRB considers these issues and makes recommendations to the Secretary and Deputy Secretary of Defense, who make the major program decision. When the DRB considers an issue that involves modernization, I am invited to participate. DOT&E has been working hard within the department to aid in the resolution of resource issues in favor of the T&E community by participating on the PRG and DRB to influence DoD resource decisions for fiscal years 2002 through 2007.

T&E Strategic Plan is being developed

After a decade of downsizing, the Service Vice Chiefs and I, in our role as the T&E Executive Agent (EA), determined that a more corporate approach to T&E issues is necessary. This approach must consider not only future T&E requirements, as identified by Joint Vision 2020, but also current realities, such as workforce reductions, skill and retention issues, and aging and deteriorating facilities. To respond to these many demands, the T&E Executive Agent is developing a corporate T&E Strategic Plan.

This Strategic Plan will guide the Military Departments and Defense Agencies in developing their Program Objective Memorandums (POMs) and in examining resource requirements 10 to 15 years beyond the POM. The plan will institutionalize a strategic review as part of the T&E investment process and should serve to bridge the gap between today's capabilities and tomorrow's technology. A successful Strategic Plan requires full participation from members of the T&E Enterprise. To achieve this end, the T&E EA has initiated a series of meetings and reviews by members of the EA, test range commanders, operational test agency commanders, members of the acquisition community (including representatives of the Service Acquisition Executives), and representatives of industry.

Members of the EA developed initial vision and mission statements and drafted goals for the plan. Test range and operational test agency commanders reviewed these items and recommended modifications, which were incorporated into the current draft of the Strategic Plan, as reflected in Figures 7 and 8.

Vision: The world's best T&E capabilities for the world's best testers - T&E capabilities to thoroughly and realistically test and evaluate weapons and support systems for the warfighter.

Mission: Provide world-class, decision support information to acquisition program managers, decision makers, and warfighters, using the full spectrum RDT&E infrastructure, to ensure operationally effective and suitable systems are fielded, while continuing to be responsible stewards of the environment.

Figure 7. Draft T&E Strategic Plan states Vision and Mission

As shown in Figure 8, the draft Strategic Plan currently includes eight draft goals. These goals may change as the plan matures. The goals focus on the developmental and operational test workforce, the decision makers, defense planners, infrastructure investments, policies, strategic partnerships, and test environments. The goals will be successfully met through the accomplishment of supporting objectives. These objectives and their implementation action plans are currently being developed.

Goal 1 - An experienced, trained, flexible, multi-skilled government civilian, military, and contractor workforce; continuously infused with new talent; to meet the nations T&E needs.

Goal 2 - A new, more complete appreciation of the value of T&E by acquisition decision makers, program managers, program executive officers, operators, defense planners, congressional members and staff, and other stakeholders.

Goal 3 - Improved infrastructure management of and better informed investments in test capabilities, facilities, and equipment to: 1) keep pace with advancing weapons technologies and changing operational conditions, and 2) ensure efficient and economical test and evaluation.

Goal 4 - Consistent core T&E standards, policies, practices, and processes for execution of T&E and full cost visibility to support "best value" determination.

Goal 5 - Policies and processes in place to test and evaluate rapidly evolving information technologies of systems ensuring real world interoperability.

Goal 6 - Early OTA involvement as an integral part of acquisition supporting warfighter requirements interpretation, program manager early insights into operational issues and where appropriate, combined T&E.

Goal 7 - Expert management of environmental and encroachment issues associated with T&E activities thus ensuring continued access to critical land, air, sea, and space environments.

Goal 8 - Strategic partnerships with program managers, other governmental agencies, industry, and academia to sustain superior T&E of weapon systems.

Figure 8. Draft T&E Strategic Plan lists draft T&E Goals

TEST RANGES AND CENTERS – WHERE TESTING OCCURS

It is critical that T&E ranges and centers be prepared for the challenge of testing the most advanced weapon systems and components and providing crucial support to the acquisition process. Responding to the challenges facing the T&E community requires facilities and capabilities that are modern, efficient, cost effective, and capable of providing the necessary data to answer critical questions on overall performance, operational effectiveness, suitability, and survivability.

The value of these T&E ranges and centers to the Department is impossible to calculate. The large areas of land, sea, and airspace at these locations are irreplaceable and absolutely essential for testing DoD systems. The need to prove the capability of long-range weapons, to provide realistic operating scenarios, and to assure the safety of personnel involved in the testing as well as personnel who are neighbors to our ranges all combine to demand the large operating environments (air, land, sea) at the ranges. On the other hand, there are only minimal costs associated with maintaining these large valuable spaces during periods when they are not in use. The reason is that the operating costs are primarily the result of the cost of the personnel used to conduct testing at the ranges. There is a similar situation with the large, expensive-to-build, ground test facilities, such as the major wind tunnels and aeropropulsion test facilities. While the construction costs for these facilities are high (and the facilities have high value to the Department), the operating costs are primarily in the personnel who run the facilities and perform the testing. When capacity becomes an issue, the operating costs can be reduced by either reducing the number of test personnel or reassigned them to other testing assignments.

Importance of the test and training ranges is recognized

Over the past decade, encroachment on our land, sea, air, space, and frequency assets on DoD test and training ranges has evolved into a major concern within the Department. Compliance with escalating environmental legal statutes, competition for airspace, and erosion of the DoD frequency spectrum, and substantial urban growth around some previously isolated ranges have strained the Department's ability to conduct quality T&E essential to system acquisition and future readiness. Unless appropriate action is taken to sustain DoD range capability, this situation will continue to deteriorate.

The DoD Senior Readiness Oversight Council (SROC), which is chaired by the Deputy Secretary of Defense, is addressing T&E and training range sustainment issues. Range sustainment issues are complex and they involve multiple federal, state, and local agencies as well as Congress and the general public. The impact of encroachment is broad, affecting our ability to execute realistic air, ground, and naval T&E and training across the nation and beyond our borders.

The SROC determined that the DoD needs a comprehensive and coordinated approach to address range sustainment issues. As the chairman of the Defense Test and Training Steering Group (DTTSG), I have established a Sustainable Ranges Working Group (SRWG) to address sustainment of the DoD T&E and training ranges and provide a strategic framework leading to the development of an effective course of action addressing key range encroachment issues. This framework will lay the foundation for ensuring both near- and long-term sustainable T&E and training range availability, resulting in the highest level of readiness possible.

Major Range and Test Facility Base (MRTFB) supports most DoD testing

The MRTFB was established as an outgrowth of a 1971 blue ribbon study that recommended the major T&E assets be organized under defense-wide regulations and have uniform use and funding policies. In addition to the MRTFB, there are a number of other locations that are unique and essential to the testing mission. Figure 9 shows the major DoD test ranges and centers that compose the MRTFB.

The following pages give brief descriptions of DoD's major test and evaluation ranges and centers. Included in each description is a summary of some of the location's capabilities, and examples of the types of testing conducted at that location over the past year. The infrastructure outlook discusses the major investments underway and addresses the requirements of each range. In some cases, the requirements are for additional resources to maintain the infrastructure or to improve a technical capability. In other cases, the needs are for solutions to management challenges. Specific needs, which require increased support from DoD and congressional leadership, are addressed below.

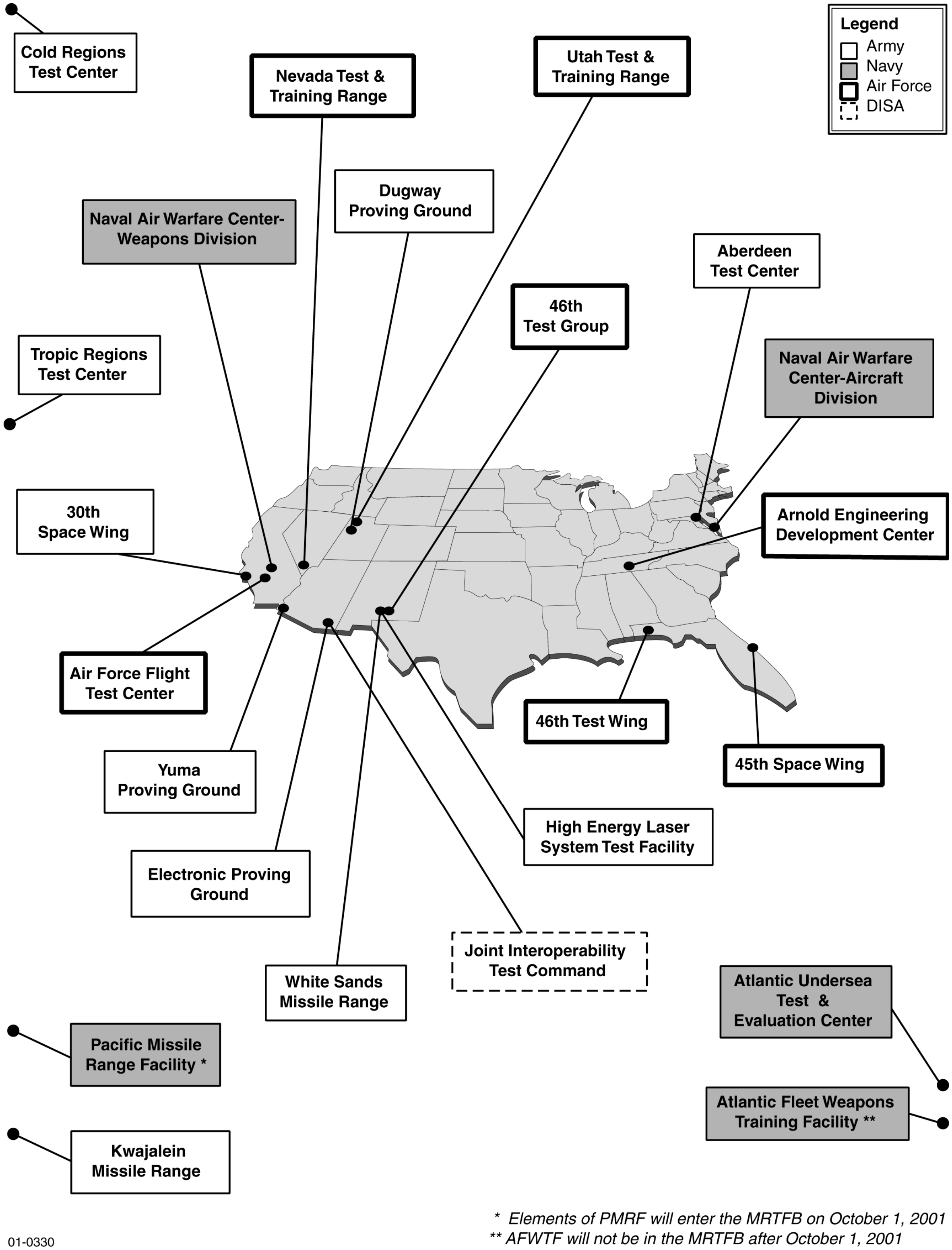


Figure 9. Major Range and Test Facility Base

ABERDEEN TEST CENTER (ATC)

U.S. Army
Aberdeen Proving Ground, MD

KEY/UNIQUE AREAS OF CAPABILITY

ATC is the DoD lead test agency for land combat, direct fire, and congressionally-mandated live fire testing. A diverse, multi-purpose proving ground, ATC encompasses 56,707 acres of land (with 40 miles of vehicle test track and 250 test ranges) and water, including restricted airspace from surface to unlimited. Entire systems as well as subsystems can be tested using ATC's facilities, simulators, and models. Items can be subjected to a large range of tests including automotive endurance and performance; full-scale live fire vulnerability, survivability, and lethality testing; and electromagnetic interference, fire safety, nuclear simulation, and surface/underwater shock and explosives testing.

TESTING IN FY2000 (767 TEST PROGRAMS AND 1,152 WORKYEARS)

ATC will be the primary test center for the new lighter-weight vehicles planned as part of the Army's transformation for the future. During FY2000 however, ATC continued to test more traditional Army systems and these systems will remain part of ATC's workload in the future. Testing of interim systems, such as the Interim Armored Vehicle, began in FY2000 and is expected to increase workload over 30 percent through FY2007.

As part of the solicitation for the Army's family of Interim Armored Vehicle systems, ATC supported the source selection by assessing the sample vehicles proposed for the Infantry Carrier Vehicle. This assessment was performed on an intense 30-day (20 hours per day, 7 days per week) schedule with the results provided to the source selection board in near real-time allowing the evaluation of written proposals and sample vehicles to be done concurrently.

ATC also supported testing of the Marine Corps Advanced Amphibious Assault Vehicle prototypes at Aberdeen Proving Ground, Quantico Marine Corps Base, and Patuxent River Naval Air Station. Data acquired from remote sites was relayed in real-time, using satellite links, to ATC, the test customer, and the contractor. ATC supported data collection from two instrumented prototypes during initial land mobility trials, water operations, and human factors tests at ATC facilities.

INFRASTRUCTURE OUTLOOK

Aberdeen Test Center, like many of the DoD test centers, is dealing with a number of workforce challenges. The ATC's civilian workforce is being reduced to meet the Department's civil service objectives. Junior civilian staff members are leaving for other opportunities (68 percent of recent resignations/transfers were below 40 years of age). Military personnel that were directly involved in testing are being reassigned and not replaced, eliminating this valuable insight from the testing process. To improve its efficiency and reduce workforce requirements, ATC is developing simulators to replace range testing. The three-phase, $38M Roadway Simulator project, funded by CTEIP, will complete its first phase in FY2002. The simulator will test two-axle, four-wheeled military and commercial vehicles from 5,000 to 26,000 pound gross vehicle weight, in a laboratory environment. The simulator will react to steering, acceleration, and braking inputs; drive axle torque; and dynamic motion of the test vehicle. Another new facility, a Bridge Crossing Simulator, will be used to quickly, accurately, and cost effectively test military bridges. It will be able to test 26-meter bridges to the crossing weight of an M-1 tank and 40-meter bridges to the crossing weight of a Heavy Equipment Transport.

ATC should complete development of a miniaturized instrumentation system to collect and record on-board technical and operational performance data on wheeled and tracked combat vehicles. This instrumentation will provide a common, embedded instrumentation system that will remain with the system from cradle to grave, providing a common platform to conduct contractor, developmental testing, training, and post fielding maintenance and logistics analysis.

COLD REGIONS TEST CENTER (CRTC)

U.S. Army
Fort Greely, AK

KEY/UNIQUE AREAS OF CAPABILITY

CRTC is DoD's cold weather, mountain test center with over 670,000 acres of land space and restricted airspace from the surface to unlimited altitude. Testing is centered at the Bolio Lake Test Facility that accommodates a full range of cold weather or temperate climate tests, depending on the season. Bolio Lake supports automotive cold-start testing and is a base for soldier equipment tests. Ranges are available for mine, explosives, and small arms tests; direct fire testing; sensor testing; air defense, missile, artillery, smoke and obscurant testing; and mobility testing. CRTC can accommodate indirect-fire testing for observed fire to 30 km and unobserved fire to 50 km. Indirect fire (up to 100 km) can also be accomplished by firing from ranges near Fort Wainwright, Alaska, with the impact on Fort Greely areas. Supporting infrastructure include a surveillance testing facility, ammunition storage area, administrative areas, communications circuits, meteorological sites, and an extensive network of roads and trails. Airfield-based and tactical air operations are supported and airdrop zones and facilities are available. Both the Army and the Air Force use CRTC ranges for training with minimum interference.

TESTING IN FY2000 (41 TEST PROGRAMS AND 41 WORKYEARS)

In FY2000, delays in the start of significant developer tests for the Bradley and 155mm Lightweight Howitzer reduced the overall workload for CRTC. These tests have been rescheduled for FY2001. Testing for the Marine Corps increased during FY2000 with the majority of the testing involving support to two Marine Corps operational tests, the Marine Corp Tactical Vehicle and the Predator (a shoulder-fired missile).

The center accomplished Missile Surveillance Tests on the Army Tactical Missile System, DRAGON, Hellfire, JAVELIN, Multiple Launch Rocket System, Patriot, and Stinger. In addition, a human factors assessment was done on the Interceptor/Modular Load-bearing Equipment. Preparations were made for testing the Armored Security Vehicle, which is used primarily by Military Police. Planned tests included a full cold weather and summer evaluation of vehicle operation, including durability, mobility, human factors, weapons firing, and fording operations.

INFRASTRUCTURE OUTLOOK

The workload at CRTC varies from year to year due to the cyclical phasing of the development programs. CRTC began implementation of BRAC 95 decisions to relocate the CRTC administrative complex from Fort Greely to Fort Wainwright, Alaska, with the start of construction of new long-term missile exposure sites at Fort Wainwright and new investments at Bolio Lake and Mississippi Ranges to ensure continuity of testing after the July 2001 BRAC completion date. The planned split of CRTC operations between Fort Greely and Fort Wainwright requires the completion of the CRTC Instrumentation Connectivity project. With the new connectivity via fiber optics, CRTC will be able to transmit high-bandwidth data from the Bolio Lake area directly to test customers and materiel evaluators. The project also includes a remote meteorological station monitoring capability. The current plan spreads the $530,000 costs over 4 years (FY2000-FY2003). Funding is also needed to improve the test instrumentation infrastructure at CRTC to facilitate testing and test data collection in severe cold environments and to develop advanced modeling capabilities for these environments.

CRTC has experienced a 90 percent decline in workload in recent years. This low level of workload does not represent the true need for cold weather testing. Program managers are accepting risk by not conducting adequate testing at extreme environments. Every DoD system should be exposed to the conditions it will experience in the hands of the warfighter. A fully capable, cold weather range must be available for systems that must operate in these extreme weather conditions. If we can get stability at CRTC after the recent realignments, the workload will increase.

DUGWAY PROVING GROUND (DPG)

U.S. Army
Dugway Proving Ground, UT

KEY/UNIQUE AREAS OF CAPABILITY

Dugway is the nation's only instrumented chemical and biological test site. This remote and isolated installation is comprised of almost 800,000 acres of desert environment that is acoustically and electronically quiet and free from population encroachment and from threatened or endangered species. DPG's primary mission is testing CB defense systems and performing nuclear, biological, and chemical survivability testing of defense materiel. Other unique capabilities include providing world-class meteorological and atmospheric modeling support to the MRTFB and other DoD and Federal agencies and testing smoke and obscurant systems and illumination devices. DPG's unique facilities include the Materiel Test Facility, which provides a one-of-a-kind capability to test the CB protection of large equipment such as a tank or fighter aircraft using chemical agents or simulants. The Life Sciences Test Facility provides a complete capability to test biological defense equipment including a one-of-a-kind chamber to challenge defense systems with aerosolized biological agents. Dugway is collocated with the Utah Test and Training Range and supports its aircraft weapons testing and training activities.

TESTING IN FY2000 (150 TEST PROGRAMS AND 324 WORKYEARS)

In FY2000, DPG conducted 150 programs in CB defense, smoke, obscurants, and illumination munitions testing; environmental characterization; and CB defense classes and training. DPG supported a number of Advanced Concept Technical Demonstrations (ACTD). For example, the Rapid Lightening ACTD provided DoD and FBI participants the opportunity to exercise operational procedures and test a commercially available decontamination system. The Restoration of Operations ACTD demonstrated the integration of mature technologies and operational concepts used to restore operations at a port or airfield after being attacked with chemical or biological weapons.

DPG also supported the Joint Vaccine Acquisition Program that developed a process to produce Tularemia vaccine and the Joint Biological Remote Early Warning System ACTD tested an early warning biological agent detection system.

INFRASTRUCTURE OUTLOOK

As the nation's only CB instrumented test site, DPG must be sustained and its workforce kept current with the CB warfare technology area. Additional manpower may be necessary to deal with increasing activity in nontraditional workload such as support to domestic CB program, CB defense classes and training, technology demonstrations, and domestic CB equipment certification.

DPG has had limited modernization funding since FY1996 and has deferred needed revitalization and modernization projects. Minor investment projects that are currently underway at DPG include the Aerodynamic Particle Sizer, the Aerosol Vapor Liquid Assessment Group Test Fixture, the Program Manager-Chemical Weapons Boundary Layer Radar Modernization, and the Test Data Storage Array.

Additional investment funding will be needed in the future for critical instrumentation and equipment needed to support advances in CB technologies. Without this funding, Dugway's test capabilities may become outdated and unusable. Acquisition programs will be affected including the Joint Chemical Detector, the Joint Protection Aircrew Ensemble as well as the Next Generation CB Ensembles and Chemical Point Detector. Also, major new test programs would be dependent on the Army airfield located at DPG, but there is an unfunded repair/replacement project for the airfield that has an estimated cost of $21M.

ELECTRONIC PROVING GROUND (EPG)

U.S. Army
Fort Huachuca, AZ

KEY/UNIQUE AREAS OF CAPABILITY

With its remote location and radio frequency interference-free environment, EPG, a subcommand of White Sands Missile Range, is the principal Army test center for electronic systems, including the developmental testing of Command, Control, Communications, Computers, and Intelligence (C4I) systems, Unmanned Aerial Vehicle (UAV) systems, and navigation and avionics systems. EPG's area of operation includes more than 9,000 square miles in and around Fort Huachuca. EPG tests distributed communication systems with emphasis on the testing of systems of systems. EPG developed the Virtual Electronic Proving Ground, which allows for testing in combined real, virtual, and constructive simulation environments. Facilities include a full range for test of electromagnetic compatibility and vulnerability of tactical electronic equipment, the intra- and interoperability of tactical automated C4I systems (including software and documentation), TEMPEST testing, and electronic countermeasures testing. EPG has an in-house developed suite of test instrumentation that includes test control, test stimulation, test data acquisition, and virtual jamming. EPG is also the flight test facility for Army's unmanned and micro-aerial vehicles and has extensive test capabilities in the areas of global positioning system testing, propagation simulation, and C4I battlefield simulations.

TESTING IN FY2000 (195 TEST PROGRAMS AND 525 WORKYEARS)

During this year, EPG was heavily involved with testing systems related to the digitization of the Army. Tests include the Force XXI Battlefield Command Brigade and Below (FBCB2) Limited User Test 2, FBCB2 National Training Center rotation, FBCB2 reliability testing, tactical operations center Electromagnetic Compatibility/Cosite testing, Joint Contingency Force exercise support, Central Test Support Facility support, and FBCB2 warfighter experiments. EPG conducted digitization technical tests, supported operational tests, and collected data and orchestrated scenario functionality during training and experiments.

EPG was also heavily involved with initial safety testing of the Interim Brigade Combat Team loaner vehicles and is scheduled to be the C4I tester for the target vehicle. Other major systems tested include the Enhanced Manpack UHF terminal; the Suite of Infrared Countermeasures; All Source Analysis System; global positioning system receiver; Guardrail/Common Sensor; Joint Tactical Information Distribution System; Near Term Digital Radio; Combat Survivor Evader Locator; Search and Rescue Satellite Aided Tracking; Tactical UAV; Micro UAV; Warfighter Simulation; Super High Frequency Tri-Band Advanced Range Extension Terminal; and fabrication support to various tactical elements at Fort Hood, Texas, and Fort Carson, Colorado.

INFRASTRUCTURE OUTLOOK

The projected FY2001 workload at EPG will be more intense, requiring more days in the field and additional, improved instrumentation. EPG's workload will not only be larger, but also more complicated and more difficult to execute. Challenges with executing this workload include the loss of test personnel and expertise due to retirement and resignations, the inability to recruit trained replacements, and the lack of sufficient instrumentation.

Project Starship is an EPG investment to provide the next-generation master controller and simulation engine. This equipment will provide a more effective and efficient test process for C4I systems in a distributed manner when all the resources required for testing (C4I systems, personnel, and instrumentation) are not available or are too costly to include. In addition, the Virtual Electronic Proving Ground (VEPG) is being developed to integrate instrumentation capabilities with legacy systems and with newly developed virtual and constructive simulations, all controlled by the Starship.

HIGH ENERGY LASER SYSTEMS TEST FACILITY (HELSTF)

U.S. Army
White Sands Missile Range, NM

KEY/UNIQUE AREAS OF CAPABILITY

In the 1980s, Congress directed the establishment of HELSTF as the nation's principal site for the testing of high-energy laser systems. The U.S. Army Space and Missile Defense Command (USASMDC) operates HELSTF as a separately managed facility located within the White Sands Missile Range (WSMR), an instrumented test range which provides 3,200 square miles of controlled land area and 7,000 square miles of controlled airspace. This permits HELSTF to accommodate live missile, rocket, artillery, mortar, and other dynamic high-energy laser engagement tests. HELSTF includes the Mid-Infrared Advanced Chemical Laser (MIRACL) and its Sea Lite Beam Director (SLBD), the nation's highest power laser and only high-energy laser/beam director integrated system. Other lower-powered lasers, pointing and tracking systems, specialized optics, a large vacuum chamber, instrumented open-air target areas, and meteorological measurement capabilities provide unique opportunities for the conduct of both laser and non-laser Directed Energy experiments. The SLBD also provides an excellent passive optical sensor for missile testing providing some of the best target imagery available at WSMR.

TESTING IN FY2000 (7 TEST PROGRAMS AND 143 WORKYEARS)

HELSTF test activity increased significantly in the past year, driven by support to the joint U.S.-Israeli Tactical High Energy Laser (THEL), a system intended to defend against terrorist attacks using small rockets. The testing at HELSTF included the entire THEL system, as well as tracking and support for the (target) rocket shoot-downs. The THEL was tested against a single armed Katyusha rocket in June during a high-power laser-tracking test. In August, THEL engaged two sequentially launched Katyusha rockets while September's test involved two simultaneous launched Katyusha rockets. In each test, WSMR launched the armed Katyusha rockets, while HELSTF provided laser testing, target support and tracking, and an instrumented test area.

In other testing, the MIRACL provided laser irradiation in tests to determine the time to cause missile warheads to detonate. The HELSTF also provided high-quality optical tracking and target imagery for missile tests at WSMR, including tests conducted for the Ballistic Missile Defense Organization.

INFRASTRUCTURE OUTLOOK

HELSTF testing in FY2001 is expected to be at a level similar to that of FY2000. The HELSTF has historically been a relatively low frequency, but high value test facility that provided unique capabilities for high-power laser testing. The importance of HELSTF has grown with forecasts of increased interest in Directed Energy (DE) applications. HELSTF is now preparing to support the Enhanced Area Air Defense (EAAD) program. This program will use advanced directed energy and/or kinetic energy technologies to provide cost-effective kill mechanisms for protecting tactical and operational forces from rockets, mortars, artillery projectiles, UAVs, and other air and missile threats.

To support the EAAD and other future DE programs, HELSTF must operate and maintain state-of-the-art laser systems and associated equipment. Current plans include installation of a solid-state laser (SSL) test bed that was developed at Lawrence Livermore National Laboratory. This test bed will support test and evaluation of four candidate laser technologies for an eventual selection of a single laser technology for incorporation in the Army air defense weapon systems.

KWAJALEIN MISSILE RANGE (KMR)

U.S. Army
Kwajalein Atoll, Republic of Marshall Islands

KEY/UNIQUE AREAS OF CAPABILITY

Located 2,300 miles southwest of Hawaii, KMR is the only U.S. treaty-approved launch site for testing strategic antiballistic missile interceptor missiles. KMR routinely supports testing of strategic and theater missile defense systems, operational and developmental reentry systems, and provides critical space operations support. Range instrumentation includes four high-power, highly sensitive radar systems operating at seven defense-relevant frequencies. Tracking radars, telemetry, optical systems, and a large-area hydro-acoustic missile impact scoring system complete the KMR instrumentation suite. The range sensors are integrated to a central control center via a high-speed, fiber-optic, intra-atoll network. Multiple target launch facilities are sited around the atoll to support intercept testing. Wake Island and Aur Atoll provide medium- and short-range target launch facilities. The primary atoll airfield handles all current U.S. air transport systems, and deep-water harbor facilities are available.

TESTING IN FY2000 (26 TEST PROGRAMS AND 2,942 WORKYEARS)

FY2000 was characterized by a heavier-than-normal workload with both a higher number of test missions and the high complexity of the National Missile Defense (NMD) and Theater Missile Defense missions. Major programs supported in FY2000 included three NMD Integrated System Tests (IST) of the exo-atmospheric kill vehicle (EKV), four associated NMD Risk-Reduction Flights (RRF), two tests of the NMD Ground-Based Radar-Prototype Radar Credible Target, a Theater Missile Defense Critical Measurements Program (TCMP) test, five operational and developmental tests of Air Force Minuteman III, and one Peacekeeper operational test.

During the three NMD Integrated Systems Tests, an unarmed Minuteman II intercontinental ballistic missile carrying target warheads was launched from Vandenberg AFB. Approximately 20 minutes later, 4,300 miles away, another missile was launched from KMR carrying a prototype interceptor, or exo-atmospheric kill vehicle. The test intercepts take place more than 100 miles above the Pacific Ocean in space. Additional tests of the NMD system involving both Kwajalein Missile Range and Vandenberg's 30th Space Wing are planned between now and 2005.

In addition, KMR had 40,000 taskings from U.S. Space Surveillance Network and 200 taskings for space object identification measurements in support of U.S. Space Command, Department of Energy, Delta and Titan missile launches, and the NASA Sharpe B reentry vehicle.

INFRASTRUCTURE OUTLOOK

The workload for FY2001 is expected to return to a more normal level with planned missions including a Theater Missile Defense Critical Measurements Program test, a Hera target demonstration test, a PAC-3 operational test, four NMD tests, three Minuteman IIIs, and one Peacekeeper.

The $91M KMR Modernization and Remoting (KMAR) project was started in FY1998 and is scheduled for completion in FY2003, but there is limited funding for other needed infrastructure projects. The KMAR has two major aspects. The first is to update four KMR radars to a common commercial-off-the-shelf system where possible. The second is to remote operations and diagnostics on Roi-Namur back to Kwajalein. When the KMAR project is completed, technical staffing in this area will be reduced by almost 20 percent. The radar upgrade will reduce custom hardware by 80 percent. The remoting will result in a 90-percent reduction in inter-island commuting. The KMR annual operating cost will be reduced by over $17M. In spite of these ongoing technical improvements, there continues to be a lack of funding for increasing KMR's communication bandwidth capability to support projected requirements of future test customers. The KMR Range Safety Control Center also requires an upgrade to meet safety requirements for planned simultaneous intercepts.

TROPIC REGIONS TEST CENTER (TRTC)

U. S. Army
Yuma Proving Ground, Yuma, AZ/Oahu, HI/Kauai, HI

KEY/UNIQUE AREAS OF CAPABILITY

The Army's Tropic Regions Test Center is headquartered at Yuma Proving Ground with test sites recently relocated to Schofield Barracks in Oahu, Hawaii, and Pacific Missile Range Facility (PMRF) in Kauai, Hawaii. These test sites will provide the necessary challenge to systems and material to assure developers and soldiers that equipment will perform reliably in the all-important natural tropical environment. Testing focuses particularly on soldier systems, communications, sensor adequacy, human factors, and performance. The hot, humid, wet climate and dense vegetation of the tropics provide the backdrop for a hostile environment for both soldiers and equipment to operate. The performance and reliability of equipment and systems in this environment can only be assured when adequate testing has been accomplished and design criteria and operational concepts have been fully incorporated. Since 1960, more than 75 percent of regional conflicts have had their roots in countries located within the tropics.

TESTING IN FY2000 (2 TEST PROGRAMS AND 15 WORKYEARS)

FY2000 was a year of relocation for TRTC. At PMRF, building of new testing facilities began for long-term exposure testing of missiles. At Schofield Barracks, a man-pack test course was prepared along with a limited administrative and logistics site. Memorandums of agreement were completed with the 25th Infantry Division for test support in Hawaii and two Cooperative Research and Development Agreements (CRADAs) were signed to allow limited use of University of Panama and Technological University of Panama facilities. TRTC expects an increase in workload in FY2001 as the relocation from Panama is completed.

Modular Light-weight Load-Carrying Equipment (MOLLE) is now undergoing developmental testing at Schofield Barracks with an operational test scheduled for next year. The MOLLE is a five-component item that allows individual soldiers to better carry the equipment necessary for sustainment during protracted periods in the field.

As part of the CRADA with the Technological University of Panama, materials exposure and performance testing (natural environmental degradation and long-term exposure testing) is continuing in Panama. Highly reflective plastic coatings and materials are being tested on behalf of the 3M Corporation while metals exposure testing is being done for the American Society of Testing Materials.

INFRASTRUCTURE OUTLOOK

The Tropic Test Center in Corozal, a sub-installation at Fort Clayton, Panama, was closed as a result of termination of the Panama Canal Treaty. Testing at Schofield Barracks and PMRF in Hawaii will be used to satisfy most of the tropic environmental testing mission. Schofield Barracks will be used for testing involving human factors effects, small arms, mobility, and soldier systems. PMRF testing will include long-term missile exposure and stockpile reliability as well as large-caliber stockpile reliability and firing programs.

The environments available at the Hawaiian sites present many of the environmental effects that are evident in the tropics; however, true tropical heat and humidity are not present in Hawaii. Without testing in true topical extremes, there could be risks in Army deployments to the tropical regions. In addition, the tropic testing workload has decreased from the significant amount in FY1997. The current workload does not represent the need for climatic testing. If we can get stability at TRTC after the relocation from Panama, the workload will increase. Every DoD system should be exposed to the conditions it will experience in the hands of the warfighter.

WHITE SANDS MISSILE RANGE (WSMR)

U.S. Army
White Sands Missile Range, NM

KEY/UNIQUE AREAS OF CAPABILITY

WSMR, one of the largest all-overland test ranges in DoD (3,200 square miles), is used for multi-service testing of air-to-ground and ground-to-ground munitions as well as surface-to-air, air defense, and fire support systems. It is a fully instrumented (radar, telemetry, optical, global positioning system, timing, and meteorological) land range with restricted airspace. WSMR has a unique combination of geography, laboratories, weather, personnel, and support activities. WSMR supports missile systems from cradle to grave, testing developmental systems and production units to assure continuing quality. WSMR operates test facilities that provide a full spectrum of battlefield environments, such as nuclear, electromagnetic, temperature, and vibration. It also has off-range launch sites for testing medium- and intermediate-range ballistic missiles at extended ranges.

TESTING IN FY2000 (500 TEST PROGRAMS AND 1,504 WORKYEARS)

WSMR supported test programs for the Army, Navy, Air Force, BMDO, foreign military sales, and other governmental agencies. Army programs included Patriot, Army Tactical Missile System (ATACMS) Block I/II and Brilliant Anti-armor Submunition (BAT), Multiple Launch Rocket System (MLRS), Guided MLRS, High Mobility Artillery Rocket System, M1 System Enhancement Program, M3A2 Bradley, and the Wolverine Combat Mobility Vehicle. Some of the major Navy programs were Evolved Sea Sparrow Missile, Rolling Airframe Missile, and Standard Missile (SM). Major Air Force programs included Airborne Laser, Advanced Medium-Range Air-to-Air Missile, and Joint Air-to-Surface Standoff Missile. WSMR also supported Theater Missile Defense Programs, joint demonstrations, and foreign tests such as Patriot Advanced Capability (PAC-3) and Standard Missile.

Two PAC-3 missions were conducted that required numerous personnel and instrumentation resources at both White Sands and Fort Wingate, and stressed the resources available for other missions. The missiles were launched from White Sands to intercept a Hera target and a Streaker drone launched into the range from Fort Wingate, New Mexico. WSMR was also the location of Navy Area Ballistic Missile Defense tests where missiles were launched from the Navy's "Desert Ship" to validate missile design, performance parameters, and the ability to intercept short-medium range ballistic missile targets, as well as aircraft and cruise missiles.

ATACMS testing was challenging to the range with its need for multi-object tracking, multi-target control, and data reduction of the optical data acquired from various range optical instruments to capture the performance of numerous dispensed munitions such as the BAT submunitions.

INFRASTRUCTURE OUTLOOK

WSMR is not funded at a level that permits the timely replacement of old and outdated radars and telemetry systems with more modern and efficient systems. In addition, funding for real property maintenance is at a level that may adversely affect test programs in the near future. WSMR did complete the construction of the Cox Range Control Center Facility and will complete the transition of all range control capabilities by mid-2001. The facility will include digital switching, composite cable, digital end devices, digital cross connect system, and a spectrum of network capabilities. The WSMR missile launch complexes are also undergoing a series of upgrades, including the launch control centers, missile engineering buildings, test operations buildings, and instrumentation and communications equipment. Other investments at WSMR include the Radio Trunking System, a new field radio system with repeaters at eight sites and the smart zone controller; the Laser Tracker Ranger, a laser tracker to achieve single station time-space-position solution for specific tests; and Virtual Proving Ground Developments for mission planning/rehearsal and safety analysis, mission playback analysis and reporting, architecture and distributed testing, nuclear effects, and integrated information systems.

YUMA PROVING GROUND (YPG)

U.S. Army
Yuma, AZ

KEY/UNIQUE AREAS OF CAPABILITY

YPG, at over 1,300 square miles in size, is larger than the state of Rhode Island and is the Army's largest desert environment test center and long- and medium-range artillery testing facility. Many miles of test courses are used for testing prototype and operational combat vehicle systems (both wheeled and tracked). Developmental testing of Army air-to-ground armament and target acquisition equipment and production acceptance testing for Army munitions programs is conducted at YPG. YPG also tests all parachute systems for personnel and air delivery of materiel and supports extensive global positioning systems testing. The extensive range facilities and support systems allow joint service combined arms testing and training. YPG is the national center for mine, countermine, and demolition testing and is responsible for desert, tropic, and cold regions testing.

TESTING IN FY2000 (324 TEST PROGRAMS AND 797 WORKYEARS)

Last year, at YPG, over 167,000 rounds were fired, 36,000 parachute drops took place, and nearly 4,000 air sorties were flown. YPG saw a 260 percent increase in equipment air drop tests in FY2000 over FY1999 and a 125 percent increase in personnel air drops tests. Helicopter testing sorties also increased by 80 percent with the beginning of Commanche tests and continuation of Longbow Apache tests. Overall, the number of test participants during FY2000 increased by 22 percent.

Testing of the long-range Crusader self-propelled 155mm howitzer was one of the most active test programs during FY2000. Tests were conducted over the entire year with well over 1000 rounds being fired. YPG built a second dedicated gun position so testing could be conducted simultaneously at two positions. Operational testing of the Crusader is planned for YPG in lieu of testing at traditional ranges such as Fort Sill since YPG can provide the extended range necessary for the Crusader. Overlapping developmental testing and operational testing will allow soldier inputs earlier in the development stage.

YPG conducted the limited user test of the Sense and Destroy Armor (SADARM), a "smart munition" projectile intended to provide all-weather, day and night enhanced counter battery capability for all 155mm howitzer systems. This testing used the 42-target array (an impact field with 42 live and/or simulated targets), the Acoustic Array (a series of directional microphones around the impact field that can determine the position of various projectile functions), and the Kineto Tracking Mount system.

The Engineering and Manufacturing Demonstration of the Battlefield Combat Identification System (BCIS) was comprised of two appliqué-equipped Bradley vehicles, one M1A1 Abrams tank, and one stand-alone unit. YPG tested the first units of the upgraded BCIS in a typical operating environment using soldiers from Ft. Knox and Ft. Benning.

INFRASTRUCTURE OUTLOOK

The Smart Weapons Test Range Complex is operational to support testing of smart mines and countermine systems that operate on acoustic, magnetic, and seismic sensors and require isolated test sites so physical input to the sensors can be controlled. YPG's Integrated Test Management Facility allows on-the-fly data basing of test data and transmission to materiel and combat developers. Requirements to test precision air drops for guided parachute technologies requires new approaches to telemetry and precision location instrumentation and will continue be drivers of future testing technology. In the area of unexploded ordnance remediation, continued development of laser cutting of high explosive munitions and bio remediation of explosive components showed promise for production quantities. The Range Digital Transmission System is being pursued to provide the capability to transfer data throughout the range via a fiber optic cable backbone. It will correct problems of limited, antiquated cable plant and dependency on a large numbers of microwave equipment. When completed, YPG will have installed over 600 miles of fiber optic cable to over 400 sites.

ATLANTIC UNDERSEA TEST AND EVALUATION CENTER (AUTEC)

U.S. Navy
West Palm Beach, FL/Andros Island, Bahamas

KEY/UNIQUE AREAS OF CAPABILITY

AUTEC operates a large underwater instrumented range of 500 contiguous square nautical miles (nm) located in a deep-water basin, 110 by 20 nm with depths of approximately 1300 to 2000 meters, off Andros Island, Bahamas. This basin is bounded on three sides by un-navigable or lightly navigated ocean areas, which make it an excellent, isolated ocean test area. AUTEC's geographically confined access provides unique, unmatched security from commercial or private encroachment. AUTEC supports Research, Development, Test and Evaluation (RDT&E) of undersea warfare systems as well as fleet training operations. AUTEC's facilities enable acquisition programs to complete critical performance milestones for torpedo and platform systems' testing. The sheltered location provides undersea acoustic noise levels that are typically below Sea State 1. This unique environment hosts the Navy's radiated noise measurement program and provides U.S. and Allied Navy platform measurement systems for basic acoustic, environmental, and oceanographic research and test programs. The NATO Fleet Operational Readiness Accuracy Check Site (FORACS) AUTEC supports the calibration of active sonar range and bearing (1–50 Hz) and passive sonar bearing (0.1–30 KHz) and the measurement of radiated noise (100 Hz-70 KHz). AUTEC has a portable three-dimensional tracking capability and survey capability, as well as a shallow-water test complex and a minefield that includes calibration spheres.

TESTING IN FY2000 (43 TEST PROGRAMS AND 828 WORKYEARS)

AUTEC testing workload during the FY2000 was relatively stable compared to prior years. Testing for foreign countries and commercial entities generates about a third of AUTEC's workload with the United Kingdom as AUTEC's largest foreign customer. Major testing of the Seawolf (SSN-21) was conducted in support of major program milestones. AUTEC provided sea- and land-based interoperability Special Forces testing and test support for Advanced Sensor Application, Periscope Imaging, Target Strength Reduction, Light Airborne Multi-Purpose System (LAMPS) III programs, and Torpedo Alertment Upgrades.

Other work included non-acoustic antisubmarine warfare and electronic support measures testing; United Kingdom (U.K.) trials; and combined U.S./U.K. Joint Operations. AUTEC supported Office of Naval Research Marine Mammal Monitoring Programs and Naval Oceanographic Airborne Lidar Bathymetric surveys in the Eastern Caribbean, provided portable marine mammal mitigation during a Composite Training Unit Exercise, and conducted integrated test and training exercises for the commanders of naval air, submarines, and surface forces in the Atlantic. AUTEC also supported the NATO Canadian programs for the Mobile FORACS and the Portable Tracking System.

INFRASTRUCTURE OUTLOOK

AUTEC continued work on the Tracking Hydrophone Replacement project and initiated radar system improvements, the Off-Board Advanced System Stimulator project, and the Underwater Range Data Communications project. The cost associated with base support is significant, with over half of AUTEC workforce involved in base support assignments. To improve the efficiency of the activity, AUTEC is initiating a reengineering effort modeled after the process used at the Air Force's Arnold Engineering Development Center. This effort will also address management's need to retain critical skill employees given AUTEC's remote location and the current labor market.

NAVAL AIR WARFARE CENTER – AIRCRAFT DIVISION (NAWC-AD)

U.S. Navy
Patuxent River, MD/Lakehurst, NJ/Key West, FL

KEY/UNIQUE AREAS OF CAPABILITY

NAWC-AD, Patuxent River, is the primary test center for Navy air vehicles and installed systems, and provides a sea-level, open-air range with access to 50,000 square miles of air space for conducting flight test operations. The open-air ranges cover regions over Chesapeake Bay and the Atlantic Ocean along the coastline of Delaware, Maryland, and Virginia. Patuxent River is also home to the Naval Test Wing Atlantic, which includes the United States Navy Test Pilot School and is comprised of more than 130 aircraft. Patuxent River MRTFB test facilities include the Air Combat Environment Test and Evaluation Facility (ACETEF); electromagnetic environmental effects test and evaluation facilities; a dynamic in-flight radar cross section measurement facility; propulsion system evaluation facilities; automatic carrier landing system facility; and shore-based steam catapults and arresting gear. The Lakehurst, New Jersey, site provides support equipment expertise and unique aircraft launch and recovery systems. The Key West, Florida, detachment provides testing of developmental anti-submarine warfare hardware in the open ocean environment.

TESTING IN FY2000 (126 TEST PROGRAMS AND 3,278 WORKYEARS)

Workload at NAWC-AD sites increased during the period between FY1997 and FY2000. The forecast for the next three years indicates relatively stable test workload from Navy users, while the workload from all users is projected to be at a level almost 35 percent above the FY1997 level.

Testing during FY2000 included the completion of the Navy's F/A-18E/F Super Hornet Operational Evaluation. The V-22 Osprey continued development testing and completed Operational Evaluation (OPEVAL). The Joint Strike Fighter demonstrated the use of Simulation Based Acquisition concepts at the ACETEF using the High Performance Computing Center to conduct distributed Virtual Strike Warfare Environment simulation events.

The Steam Catapult Test Facility was used to test new safety modifications to the Navy's T-45 Goshawk trainer aircraft. The developmental test programs for the E-2C eight-blade propeller system and the SH-60R were also started.

INFRASTRUCTURE OUTLOOK

NAWC-AD has made significant investments in the last few years. Most of the facilities at Patuxent River are considered state-of-the-art. Investments are being made to provide increased capability. These include the Electromagnetic Environmental Effects Generating System project, which was CTEIP-funded and will provide a test facility capable of assessing the actual performance of a full-scale, fixed-, or rotary-wing aircraft completely immersed in a user-specified, high-intensity, radio frequency (RF) environment.

The increased use of composites, exotic materials, and complex, low-power microelectronics in aircraft and other weapon systems can increase susceptibility to the threat associated with electromagnetic transients. The CTEIP-funded Electromagnetic Transient Test and Evaluation Facility provides Electromagnetic Pulse (EMP), lightning, and electrostatic multi-Service test facilities to evaluate the resources of full-scale aircraft, including small and cargo-sized aircraft. This project is developing new test environments and capabilities in EMP, lightning, and electrostatic charge to correct the present shortfalls in meeting the electromagnetic transient environments.

NAVAL AIR WARFARE CENTER – WEAPONS DIVISION (NAWC-WD)

U.S. Navy
China Lake, CA/Point Mugu, CA/WSMR, NM

KEY/UNIQUE AREAS OF CAPABILITY

NAWC-WD provides test and evaluation of weapons and weapons systems, aircraft weapons integration, and recovery systems. Major capabilities include two weapons test squadrons; fully instrumented air, land, sea, and electronic warfare ranges; ordnance, propulsion, warhead and explosive test facilities; simulation laboratories; military-target ranges; parachute recovery; gun ranges; live-fire weapon survivability facilities; and target and threat systems facilities. NAWC-WD ranges include 1.1 million acres of land space, 17,000 square miles of military restricted airspace, 125,000 square miles of instrumented sea range with 36,000 square miles of controlled overlying airspace, a deep draft port facility, and an airfield and instrumentation at San Nicolas Island. The Sea Range has the interconnectivity needed to support large complex operations and uses an approved flight corridor between the sea/land air ranges for land attack cruise missiles. The Electronic Combat Range provides free-space testing of airborne electronic warfare systems and tactics against shipboard and land-based air defense systems. NAWC-WD capabilities include the Navy's land-locked ship simulator ("Desert Ship") at White Sands Missile Range for testing shipboard fire control and ship-based missiles.

TESTING IN FY2000 (212 TEST PROGRAMS AND 2,080 WORK YEARS)

NAWC-WD projects that its test workload from Navy users in the years FY2000-2003 will be relatively stable and at a level about 18 percent below the level in FY1997. The total testing workload is projected to be about 13 percent below the FY1997 level.

Major test programs supported during FY2000 include eight air launches of the AIM-9X supporting the Low Rate Initial Production decision, the first AIM-9M separation firing from the F-22, and six SLAM-ER launches for Navy OPEVAL, and several developmental test missions. Operational Test Launches of Cruise Missiles and Tactical Tomahawks warhead penetration tests were conducted.

More than 70 Joint Direct Attack Munition (JDAM) weapons were launched for verification and validation (V&V) of software and for the Navy OPEVAL. Operational flight program V&V's were conducted for the F/A-18C/D/E/F. Other major testing included SPQ-9B radar, Integrated Defense Electronic Countermeasures (IDECM), and AV-8B. Support was also provided to extensive training conducted by Navy Air Pacific and the Third Fleet.

INFRASTRUCTURE OUTLOOK

Test programs have been negatively impacted by the lack of sufficient spares to maintain test support aircraft at NAWC-WD. While these aircraft are assigned a lower priority than operational aircraft, test support aircraft must have sufficient operational availability to support acquisition program schedules.

NAWC-WD pursued investments to upgrade and enhance its test capability. The investments during FY2000 included air route surveillance radar installation and FPS-16 radar service life extension, Navy integrated target control, San Nicolas Island data cable replacement, Navy GPS Advanced Range Data System upgrades, sea range telemetry systems and land range remote telemetry coverage, mobile optical tracking mounts, and range air traffic surveillance modernization.

The CTEIP-funded IBIS Hammer project is a high-technology foreign surface-to-air missile (SAM) system. The system is a mobile, medium-range SAM designed to defend ground forces from aerial attack by fixed- and rotary-wing aircraft. It will be instrumented to insure the commonality of data products between Electronic Combat Range and Western Test Range. This project will provide an instrumented threat asset to enhance the multiple threat environments at ECR and will support the testing of EA-6B, FA-18E/F, and ALE-50.

PACIFIC MISSILE RANGE FACILITY (PMRF)

U.S. Navy
Kauai, HI

KEY/UNIQUE AREAS OF CAPABILITY

PMRF is the world's largest instrumented, multi-environment sea range capable of supporting surface, subsurface, air, and space operations. One thousand square miles of instrumented underwater range and over 42,000 square miles of controlled airspace make PMRF a leading range for supporting operations from small, single-unit exercises to large, multiple-unit battle group scenarios. PMRF supports both testing and training missions. When needed, PMRF has cleared over one million square miles of surface and airspace for Navy ballistic missile defense testing. PMRF is linked to other range and data-processing facilities and can transmit real-time test data and video to DoD sites nationwide via microwave, fiber-optic, and satellite networks. While primarily a training range, it is the Navy's primary site for ballistic missile defense testing.

TESTING IN FY2000 (11 TEST PROGRAMS AND 48 WORKYEARS)

PMRF is the primary test facility for the Navy Theater-Wide Ballistic Missile Defense (TBMD) and Navy Area Ballistic Missile Defense programs, and supported various tests and training requirements associated with these programs during FY2000. Key test events in FY2000 included Flight Test Round-1 (FTR-1) and Pacific Blitz. FTR-1 was the first shipboard firing of the Standard Missile-3 (SM-3) missile. This test was part of a series of ballistic missile defense tests that will lead to the intercept of simulated enemy ballistic missiles.

PMRF was the site of the Pacific Blitz exercise, a complex missile defense and tracking event conducted to evaluate the Navy's progress and accomplishments in developing a Navy TBMD. It involved five simultaneous aerial targets, of which four were ballistic, and was part of the biennial, multi-national, Rim of the Pacific (RIMPAC) exercise. Navy, Marine Corps, Army, and Air Force systems tracked and shared data on six nearly simultaneously launched target missiles.

PMRF was also the site of the July 2000 test of the Navy Theater-Wide Aegis LEAP Intercept Flight Test Round. This was the second in a series of nine evaluation flights of the Navy's new long-range exo-atmospheric missile designed to counter the theater ballistic missile threat.

Other Navy testing at PMRF included Standard Missile 2 developmental and operational tests, Submarine Weapon Systems accuracy tests, and E2 Radar modernization research. Air Force tests were done for Minuteman and Peacekeeper, while support was provided for the Army's Tropical Test Center and NASA's ALTUS Unmanned Aerial Vehicle.

INFRASTRUCTURE OUTLOOK

Selected test facilities at PMRF will be added to the MRTFB in FY2002. PMRF has a multi-year instrumentation upgrade program that includes installation of three advanced radars (two fixed and one on a mobile sea-going platform), telemetry upgrades, missile assembly building and magazines, Stabilized High Accuracy Optics Tracking System (SHOTS), Mobile Aerial Target Support System (MATSS) Sea going Mobile Sensor Platform, MK-74 X-band Radar, and range operations computer and communications upgrades. Additional effort may be required to fully integrate these improvements and to fully realize their benefits in total test mission control and data collection for the complex ballistic missile missions.

PMRF has significant issues with its aging workforce. There is limited upward mobility, limited new hires, and insufficient high-grade positions to attract a high-quality workforce. The Navy is working on a longer-term plan to sustain the capabilities of PMRF and ensure that improvements and modernizations are planned, funded, and executed.

AIR ARMAMENT CENTER (AAC), 46TH TEST WING (46TW)

U.S. Air Force
Eglin Air Force Base, FL

KEY/UNIQUE AREAS OF CAPABILITY

The 46TW tests air-delivered weapons, navigation/guidance systems, and Command and Control (C2) systems using its unique sea and land ranges as well as ground test facilities. The Eglin Gulf Test Range (GTR) provides 100,000 square miles of overwater airspace. The land range covers 724 square miles and contains 51 test and training areas, including a depleted uranium test range and the only qualified air-to-ground supersonic range east of the Mississippi River. The Armament/C2 Systems Test Environment consists of precision instrumentation for data collection, microwave systems for data transfer, and radio and land communication networks to support tests. The unique McKinley Climatic Laboratory simulates rain, snow, icing, dust, sand, salt, fog, humidity, and solar radiation in six chambers. The main chamber will hold all operational aircraft, including the C-5. The Guided Weapons Evaluation Facility (GWEF) tests precision-guided weapons in simulated “real world” environments. The Preflight Integration of Munitions and Electronic Systems (PRIMES) Test Facility performs installed systems testing of air-to-air and air-to-surface munitions and electronics systems full-scale aircraft. The 46th Test Group at Holloman AFB, New Mexico, reports to the 46TW.

TESTING IN FY2000 (325 TEST PROGRAMS AND 2,556 WORKYEARS)

The 46TW performed testing for systems included precision-guided weapons (such as Joint Air-to-Surface Standoff Missile (JASSM), Enhanced GBU-15 (EGBU-15), and AIM-9X) and C2 systems (such as the Theater Battle Management Core Systems). Installed systems testing included air-to-air and air-to-surface munitions and electronics systems on aircraft and land vehicles. The McKinley Climatic Laboratory supported numerous tests of aircraft, avionics systems, and commercial test items.

Joint Air-to-Surface Standoff Missile (JASSM) testing included the launch of the first powered JASSM from an F-16. Supporting tests included engine firings in the climactic laboratory, separation analyses, aircraft integration tests, and live-fire tests on the JASSM and its fuses.

Numerous aircraft/store combinations were evaluated under the Seek Eagle program for safe carriage and separation. F-16 testing included the Wind Corrected Munitions Dispenser (WCMD), AGM-88, next-generation cargo pod, and aircraft flutter and loads validation missions. F-15E testing included WCMD, GBU-27 separation, and BDU-33 ballistic accuracy verification.

Other significant test programs supported by the 46TW include ammunition for Advanced Amphibious Assault Vehicle, AIM-9X, Directional Infra-Red Counter Measures, Hellfire, PATRIOT, Advanced Short Range Air-to-Air Missile, Link 16, and the Air Force Mission Support System.

INFRASTRUCTURE OUTLOOK

A large portion of the civilian scientific, technical, and engineering workforce at the 46TW is retirement eligible. Thus, the wing management must monitor the workforce to ensure the proper skill levels are maintained. In some specialized test facilities, such as the climatic hanger, it is a management challenge to adjust to program delays in major testing efforts. In these facilities, the workforce requires specialized skills, and when a planned test program is delayed, there can be significant unplanned costs as a result of the underused workforce.

The 46TW is continuing to upgrade various test capabilities. Expanded radar and midwave IR simulators were recently completed upgrades to the GWEF. Continuation of upgrades to TSPI systems, telemetry, microwave, communications, arenas, gun test, and photo-optics are occurring at the ASTE Range Systems. To improve the PRIMES capability, development of aircraft/munitions interface simulations for F-15 and F-16, and advanced signature generator upgrades were initiated, as well as the completion of the Com/Nav simulator data link.

AIR ARMAMENT CENTER, 46TH TEST WING, 46TH TEST GROUP (46TG)

U.S. Air Force
Holloman Air Force Base, NM

KEY/UNIQUE AREAS OF CAPABILITY

Part of Eglin's 46th Test Wing, the 46th Test Group provides a unique combination of test and evaluation services and state-of-the-art measurement and support facilities for guidance and navigation testing, sled track testing, radar cross section testing, and flight testing. The Central Integrated Guidance Test Facility (CIGTF) is the DoD center of expertise for the test and evaluation of Inertial Navigation Systems (INS), the Global Positioning System (GPS), and blended GPS/INS components and systems in both benign and electronic warfare environments. The Holloman High Speed Test Track (HHSTT) provides the only hypersonic sled test capability in the world and is the DoD's lead track facility and track center of expertise for aircraft escape system testing, full scale lethality testing, electronic countermeasure systems, explosive blast effects, environmental erosion, dispenser testing, and hypersonic environmental testing. The National Radar Cross Section (RCS) Test Facility (NRTF) is a one-of-a-kind facility combining the best monostatic and bistatic RCS measurements. The NRTF is moving toward consolidation with industry and is completing significant technology improvements to address advanced stealth techniques.

TESTING IN FY2000 (114 TEST PROGRAMS AND 515 WORKYEARS)

FY2000 testing involved all major facilities and assets. CIGTF performed laboratory, field, and flight testing in two major categories, GPS Vulnerability and GPS Performance. In these categories, CIGTF tested avionics (Miniature Airborne Onboard Processing (GPS) Receiver 2000), Battle Labs (Perimeter Protection), Joint Test and Evaluation), Vulnerability/Jamming Programs, and Special Projects.

The HHSTT performed lethality testing for the Army's Theater High Altitude Area Defense System and the Navy's Standard Missile 2, aircraft escape system testing for the F-22 aircraft and improvements to the ACES II seat, and Electronic Countermeasure (ECM) systems testing for Project ECM and the Army's Suite of Integrated Infrared Countermeasures.

The NRTF conducted both monostatic and bistatic tests during FY2000. Two of the bistatic test programs utilized the new Bistatic Coherent Measurement System (BICOMS). The 46TG used its newly acquired C-12J to conduct tests for the North Warning System (NWS), the Humvee-mounted system of Advanced Medium Range Air-to-Air Missiles (HUMRAAM), and Miniature Airborne Onboard Processing (GPS) Receiver 2000 (MAGR-2000) test programs.

INFRASTRUCTURE OUTLOOK

The CTEIP-funded upgrade to the HHSTT consists of design, development, fabrication, and test of new slipper/rail interfaces to address slipper wear, rail gorging, and excessive impact loads, as well as the development of a new rocket motor for the sled. The HHSTT upgrade will provide more reliability to current and future hypersonic test customers. Test reliability for HHSTT customers will be increased to above 90 percent for tests at velocities up to Mach 7. The HHSTT is experiencing high workload, but needs additional funding to expedite the refurbishment and repairs to cracked rails in the older portion of the track.

The 46 TG has developed a unique partnership arrangement with The Boeing Company at the NRTF at Holloman AFB. This arrangement benefits both parties and will result in reduced cost to the U.S. taxpayers. Additional funding would expedite efficiency upgrades at the NRTF and provide expanded test capability in this important area.

AIR FORCE FLIGHT TEST CENTER (AFFTC)

U.S. Air Force
Edwards Air Force Base, CA

KEY/UNIQUE AREAS OF CAPABILITY

AFFTC is the Air Force aircraft and aircraft systems development test and evaluation center for both manned and unmanned vehicles. It is located within 20,000 square miles of highly instrumented ranges, permitting unrestricted flight testing from near ground level to near space. AFFTC offers excellent year-around flying weather, relative isolation, and varied topography, including Rogers Dry Lake, a vast natural landing field that has saved countless lives and billions of dollars worth of test aircraft. In addition to open-air test ranges, AFFTC has an array of ground test facilities, including the Avionics Test and Integration Complex, which allows for complete testing of a fully integrated avionics suite in a simulated flight environment including electronic threats and software checkout. Other ground test facilities include the Test and Evaluation Modeling and Simulation facility; systems integration laboratories; hardware-in-the-loop facilities; and installed systems test facilities, such as the Benefield Anechoic Facility, the largest anechoic chamber in the world. Engine test facilities include one of only three fully automated engine test cells in the country.

TESTING IN FY2000 (221 TEST PROGRAMS AND 5,485 WORKYEARS)

The F-22 test aircraft fleet expanded to three this year. F-22 testing continued in the areas of avionics and weapons integration, open weapons bay tests, envelope expansion, and post-stall high angle-of-attack with thrust vectoring. AIM-9 separation tests from the F-22 were completed as well as tests for high angle-of-attack maneuvering in support of a program milestone review.

The Joint Strike Fighter (JSF) Joint Test Force completed preparations for arrival of the JSF prototypes and initial flight tests. The first prototype arrived in September.

The CV-22 project completed detailed test planning and the first test CV-22 test aircraft also arrived at AFFTC in September. The F-16 testing involved an Operational Flight Program (OFP) for capability improvements of the Modular Mission Computer, High-Speed Anti-Radiation Missile (HARM) Targeting System, and Digital Electronic Engine Controls.

INFRASTRUCTURE OUTLOOK

AFFTC workload for FY2001 is forecasted to be roughly the same as FY2000. AFFTC continues to pursue infrastructure investments toward the goal of providing fully integrated testing capabilities to meet advanced weapon systems requirements. This will include development of radio frequency (RF) simulation capabilities and integrated data collection and processing capabilities to meet requirements for real time processing, archiving, and display of high volumes of test data.

Upgrades will continue to the Electronic Combat Integrated Test (ECIT) facility to provide RF simulation capability to support advanced weapon systems requirements. The Advanced Data Acquisition and Processing Systems (ADAPS) project provides an integrated capability to satisfy real-time, first-generation, post-test data processing, archival, and display requirements of the next decade and the potential to satisfy data processing and display needs at various multi-Service test ranges.

AFFTC's aging test support fleet requires expensive upgrades, including engine upgrades for F-15 and F-16 aircraft as well as F-16 structure life extension programs. This trend may be reversing for F-16s with the potential acquisition of Peace Gate F-16's. If this acquisition is successful, AFFTC will receive two new F-16A and seven F-16B models to replace older support aircraft. AFFTC plans to deactivate its Advanced Range Instrumentation Aircraft (ARIA) in FY2002. Navy P-3 aircraft and satellites do not have the full capability to replace the ARIA, so compromises will have to be made. Maintenance of the infrastructure continues to be a concern as portions of the physical plant are deteriorating. For example, heavy use portions of the 3-mile long runway require repair.

ARNOLD ENGINEERING DEVELOPMENT CENTER (AEDC)

U.S. Air Force
Arnold Air Force Base, TN/White Oak, MD

KEY/UNIQUE AREAS OF CAPABILITY

AEDC is the nation's most advanced and largest complex of flight simulation and ground test facilities. Facilities include 58 aerodynamic (subsonic, supersonic, and hypersonic) and propulsion wind tunnels, rocket and turbine engine test cells, space environmental chambers, arc heaters, ballistic ranges, and other specialized units. Fourteen of these facilities are unmatched in the world. Advanced turbine engine and rocket propulsion facilities can simulate high-altitude operations (up to 100,000 feet altitude) even during testing of large, high-thrust engines. The Aeropropulsion Systems Test Facility, the largest, most capable engine test facility in the world, can simulate flight conditions and transient conditions of takeoff, climb, multi-speed combat maneuvers, descent, and landing, all using full-scale elements of an aircraft propulsion system or, in some cases, the complete propulsion system. Unique sea-level engine test cells provide the capability to perform accelerated engine durability testing and testing of engines in hostile environments (e.g., salt water atmosphere, icing conditions, and sand/dust ingestion). AEDC also operates a hypersonic wind tunnel at White Oak, Maryland.

TESTING IN FY2000 (86 TEST PROGRAMS AND 2,454 WORKYEARS)

AEDC aeropropulsion testing in FY2000 included the completion of both the EMD phase of the F-22's F119 engine and the concept validation phase of the JSF engines (both competitors' versions). Extensive testing was also performed on current F-15 and F-16 fighter engines in support of the USAF Component Improvement Program.

Aerodynamic wind tunnel testing in FY2000 included store separations testing of the Joint Air to Surface Standoff Missile (JASSM) from the B-1B. This testing is expected to reduce the required flight tests from 15 to 20 down to 7 or 8 flights. Store separations testing was also performed on the F/A-18E/F. Stability and control, pressure, drag, inlet integration, jet effects, and store separation tests were performed on both Boeing and Lockheed versions of the Joint Strike Fighter (JSF). Overall, wind tunnel output was 25 percent over the projected workload.

AEDC performed space simulation testing on Loral Space System's GOES commercial weather satellite in the Mark I Space chamber. G-Range provided impact lethality testing in support of the National Missile Defense (NMD) program. Simulated flight altitude testing on Minuteman Stage II and III rocket motors was performed in the J6 Rocket test facility. Heatshield and leading edge materials testing was performed in AEDC's Arc heater facilities to evaluate ablation performance and thermostructural reliability prior to flight. The Advanced Missile Signature Center (AMSC) collected missile signature data in support of various programs.

INFRASTRUCTURE OUTLOOK

AEDC is performing important testing using its upgraded, mostly 40-year-old facilities. We must insure that these unique facilities are upgraded and modernized and that investment funding is available to replace some of the aging facilities. Since Navy propulsion testing has been brought to AEDC, these facilities are even more important. In cooperation with NASA, new aeronautical testing capabilities are being defined to meet future national needs.

During FY2000, AEDC's aging infrastructure experienced a number of failures, including a damaged plant heater, transformer, plant motor, and a Propulsion Wind Tunnel starting motor, resulting in unexpected repair costs of $4.6M and delaying some FY2000 test programs until FY2001. To minimize the impact of unforeseen failures like these in the future, AEDC is aggressively managing its funds and pursuing infrastructure maintenance and repairs. AEDC has embarked on an aggressive upgrade/modernization schedule to include installing data acquisition and processing systems in both 16-foot wind tunnels, designing electric motor upgrades, and planning flow-quality improvements.

NEVADA TEST AND TRAINING RANGE (NTTR)

U.S. Air Force
Nellis Air Force Base, NV

KEY/UNIQUE AREAS OF CAPABILITY

With 12,000 square miles of airspace over 3,000,000 acres of ground space, NTTR is the largest range in the United States. With its primary mission of training combat aircrews, NTTR has a variety of threats (fixed and moving) and targets that are useful for conducting both developmental and operational testing for combat aircraft. NTTR supports operational testing for combat aircraft to ensure new and upgraded systems meet operational requirements. Tactics Development and Evaluation tests are conducted to guarantee aircrews are provided sound combat tactics in concert with new or upgraded systems. Test results are passed on to the USAF Weapons School to incorporate into training sorties and to the operational units to use in continuation training at their home stations or in large training exercises, such as Red Flag. NTTR provides unique instrumentation for tracking up to 100 high-activity aircraft participating in multiple missions for data collection and mission debriefing. Weapons scoring systems and tracking are available to support weapon system testing.

TESTING IN FY2000 (25 TEST PROGRAMS AND 726 WORKYEARS)

NTTR supports the conduct of operational tests in simulated combat environments for new aircraft as well as upgrades to existing aircraft such as the A-10, F-15C, F-15E, F-16C, and HH-60G aircraft.

Joint Test and Evaluation of Joint Suppression of Enemy Air Defenses was conducted at NTTR. It is an OSD-sponsored test designed to gather data on a baseline and enhance Intelligence, Surveillance and Reconnaissance architecture.

The Joint Expeditionary Force Experiment was a series of Air Force Chief of Staff–sponsored warfighter experiments to expedite the building of the Expeditionary Air Force. Primary themes were advanced command and control concepts and technologies to achieve the vision for Global Engagement.

Unmanned Aerial Vehicle (UAV) Battlelab at Eglin AFB joined with the Joint Surveillance Target Attack Radar System (JSTARS) in an imaging demonstration on the NTTR. The purpose of this demo was to show the military worth of providing JSTARS with real-time UAV ground target imagery to support precision targeting and attack, and a maturing battle management capability. The UAV continues to be tested in a variety of combat support roles.

INFRASTRUCTURE OUTLOOK

While NTTR is host to a large number of training activities, it also provides valuable support to testing. The high usage planned as part of future F-22 testing may impact NTTR ability to continue support to test and training customers through FY2003.

A number of areas require unfunded improvements to maintain NTTR support to its users. These areas include $12M for fiber optic links to remote sites and encryption, $4.5M for more realistic targets, and $5M for Tonopah airfield and runway projects. On an annual basis, additional funding is required for rental of advanced threats, and for new range support and technical contracts.

During FY2000, NTTR made investments in upgrades to the Nellis Range Support System, Nellis Air Combat Training System, Nellis Air Weapons Control System, Red Forces Command and Control, and Air Warrior Video Teleconference. NTTR also developed urban targets and installed a fiber optic network on the range. Also, NTTR was able to expand the use of its northern most range airspace by working with the FAA to redirect the nearby commercial airway away from the range space.

UTAH TEST AND TRAINING RANGE (UTTR)

U. S. Air Force
Hill Air Force Base, UT

KEY/UNIQUE AREAS OF CAPABILITY

UTTR is the primary, large footprint, open-air operational test and training range for DoD's precision guided, air-to-ground, weapons and munitions. UTTR's testing is characterized by its large airspace, exceptionally long supersonic corridors, extensive shoot box, large safety footprint area, varying terrain, and remote location. UTTR has a large block of overland, contiguous special-use airspace (12,574 square nautical miles) and one of the largest overland safety footprints available in DoD (2,675 square miles). It supports developmental and operational T&E of cruise missiles, unmanned air vehicles, munitions, and advanced weapons systems. UTTR is ideal for testing smart munitions, long-range standoff weapons, cruise missiles; boost-glide precision-guided munitions, and autonomous loitering anti-radiation missiles. Rocket motors for ICBMs and tactical weapons are tested on static firing facilities. Numerous areas are used for precision monitored explosive propagation tests and munitions "shelf-life" tests. Tests of up to 500,000 pounds of conventional explosive can be conducted at UTTR.

TESTING IN FY2000 (37 TEST PROGRAMS AND 310 WORKYEARS)

UTTR test activities include air munitions sustainment and flight testing (CBU munitions, fuses, mechanical fin's, air retarding system, flares, and chaff); Wind Corrected Munitions Dispenser (WCMD) developmental and operational testing, enhanced GBU-15 operational testing; tactics developmental and evaluation for the Joint Direct Attack Munition (JDAM); and Minuteman and Trident motor ground tests.

As part of the annual air-to-ground Weapon System Evaluation Program (WSEP), participating squadrons performed tactical deliveries of precision-guided munitions and other high-technology weapons and UTTR assessed, collected, and analyzed data covering the full scope of the surface attack mission. This included munitions storage, weapons buildup, launch, impact, and target damage assessment. Weapons delivered were the GBU-10, 12, 24, 27, and the AGM-130, 65, 88, 142, and 154. challenge the pilots in realistic threat environments, both air-to-air and surface-to-air adversarial defenses were employed. A number of moving tanks were developed and individually deployed as targets for the AGM-65.

In support of the Nuclear WSEP, five to six Air-Launched Cruise Missile and Advanced Cruise Missile tests are performed each year at UTTR. Each of these missions involves eight aircraft, personnel from at least nine organizations, the entire south range, and virtually all range test assets.

INFRASTRUCTURE OUTLOOK

In the last eight years, UTTR has received minimal Improvement and Modernization funding. The top three priorities at UTTR are air operations and air traffic command and control ($3.0M); test and training instrumentation ($8.7M); and test and training communications backbone ($4.7M). The command and control project would provide more versatile, supportable, joint service support with greater control over test and training activities. Instrumentation upgrades would provide enhanced radar, telemetry, and optical support for their customers. The communications backbone would allow greater control over all radio circuits, land lines, and their distribution. These upgrades are needed to improve capabilities to support training and cruise missile testing, enhance test data integrity, and improve optical instrumentation.

Some operational T&E targets have been integrated into training target areas and share time-space-position information systems. Capabilities required to support munitions and weapons in operational T&E (OT&E) and tactics development and evaluation (TD&E) have been integrated into training for pilot proficiency and large joint exercises.

30TH SPACE WING (30SW)

U.S. Air Force
Vandenberg Air Force Base, CA

KEY/UNIQUE AREAS OF CAPABILITY

30th Space Wing has the only national capability to launch space systems into polar orbit due to Vandenberg AFB's natural geographic location. It supports small through heavy lift launch systems (Titan, Atlas, Delta, and Pegasus). With Kwajalein Missile Range (KMR), it provides full ballistic missile operational test facilities (Minuteman and Peacekeeper) and R&D payload testing (sub-orbital reentry vehicle tests). The Western Range (WR) is managed by 30SW including all instrumentation (radar, optical, and communications) and telemetry systems. As a secondary mission, 30SW supports testing of aeronautical systems for other test ranges. The West Coast Offshore Operating Area, also managed by the 30 SW, is an aeronautical, ballistic missile, and guided missile test area,. This 200 by 1000 mile "over-water" area is located off the California/Oregon coastline. As a tertiary mission, 30SW supports the U.S. Space Command Space Surveillance Network.

TESTING IN FY2000 (1,756 WORKYEARS)

The number of launches in FY2000 was nearly the same as in FY1999, and is expected to increase significantly over the next few years. The range capacity of 30SW increased significantly in FY1999. The launch pad capacity began to increase in FY1997 and, by FY2001, will exceed the range capacity.

As part of three major National Missile Defense (NMD) tests during FY2000, Vandenberg AFB was the launch site for unarmed Minuteman II ICBMs carrying target warheads. The tests involved the launching of the target missile, followed by the launch, 4,300 miles away at Kwajalein Missile Range (KMR), of a prototype interceptor, or exoatmospheric kill vehicle. The intercepts were planned more than 100 miles above the Pacific Ocean. Additional tests involving the 30SW and KMR are planned between now and 2005.

30SW also supported launch of an unarmed Minuteman III ICBM as part of the Air Force's Force Development Evaluation Program. This program is designed to test the reliability and accuracy of Minutemen weapon system and to extend the life of the Minuteman booster. The first launch of the Lockheed Martin Atlas IIAS from Vandenberg AFB carried the NASA Terra satellite into orbit. A Boeing Delta II rocket carrying the IMAGE spacecraft was launched from Vandenberg's Space Launch Complex 2.

The Wing supported Pegasus rocket launched from an L-1011 aircraft carrying two DoD Space Experiments: Space Technology Research Vehicle-2 and the Compact Environmental Anomaly Sensor. 30SW also supported the launch of two Orbital Taurus launch vehicles.

INFRASTRUCTURE OUTLOOK

Phase II of the Range Standardization and Automation initiative provides for an Operation Control Center and short-range instrumentation facilities on Vandenberg AFB as well as upgrades to communications, air/sea/rail surveillance, vehicle tracking, optics, and weather forecasting. Phase II also includes long range instrumentation facilities at Pillar Point and Point Mugu as well as a radar for Kaena Point. This will increase the efficiency of the 30SW and improve future range test capabilities.

45TH SPACE WING (45SW)

U.S. Air Force
Patrick Air Force Base (PAFB)/Cape Canaveral AFS (CCAFS), FL

KEY/UNIQUE AREAS OF CAPABILITY

The 45SW is the nation's primary space launch facility for geosynchronous orbits and interplanetary space missions. Low/medium earth and highly elliptical orbits are also supported. The Wing supports various DoD, NASA, and commercial satellite and manned launch systems including Titan IV, Delta II/III, Atlas II/III, Pegasus, Space Shuttle, and Trident I/II. Preparations are ongoing for the Evolved Expendable Launch Vehicle program; first launch is scheduled for FY2001. The 45SW also supports Centaur, Inertial Upper Stage, and Atlas/Delta upper stages. The Eastern Range instrumentation includes radar, optical tracking, command and control, communications, range safety, and telemetry systems. A full range of satellite launch preparation, processing, and support facilities are available. The 45SW also provides extensive support to the U.S. Space Command's Space Surveillance Network.

TESTING IN FY2000 (2,177 WORKYEARS)

The number of launches at the 45SW increased in FY2000 from FY1999 and is expected to continue to increase. The range capacity of 45SW will increase in FY2003. The maximum launch pad capacity began increasing in FY1999 and will peak in FY2002. For the last several years, almost half of the launch activity supported by the 45SW at CCAFS has been commercial.

CCAFS was the site for the launch of a Titan IV/B-IUS rocket carrying a Defense Support Program (DSP) satellite into a 22,300-mile geosynchronous orbit. DSP satellites are part of North America's early warning system; helping to protect the United States and its allies by detecting missile and space launches as well as nuclear detonations.

There were four Delta II and one Delta III rocket launches. Three GPS satellites were launched in FY2000 (GPS IIR-3, IIR-4, and IIR-5) to sustain the current constellation. These GPS satellites provide the warfighter with precision targeting and navigation. A commercial Delta launched a Globalstar 7 satellite this year. In addition, the Delta III rocket system was checked out by launching an inert payload into orbit.

Seven Atlas rockets were launched with four carrying government satellites. Two commercial Atlas rockets launched the Hispasat-C and Eachostar VI satellites. Also, an Atlas III launched an Eutelsat WIV into orbit for European Satellite Operator. At sea, operational test launches of four Trident missiles were also supported.

INFRASTRUCTURE OUTLOOK

The Range Standardization and Automation (RSA) initiative is a three-phase program for overhauling and redesigning both the Western and Eastern ranges. Phase I addresses immediate needs, Phase IIA provides a new range architecture, and Phase IIB replaces fixed assets at CCAFS, Argentia, Bermuda, Jonathon Dickinson Missile Tracking Annex, Antigua, and Ascension. A related improvement and modernization sustainment investment will extend the life of downrange antennas and electronics.

The Air Force and NASA are working hard to improve the efficiency of the support contracts at their respective launch complexes. The commercial space launches place an additional demand on the management of these facilities. Both the 30th and 45th Space Wings should examine the potential of converting to GPS-based tracking systems on their ranges. If this option is adopted, future investment will be required to realize the potential for these space ranges. The Navy is departing Argentia, Newfoundland, where the 45th Space Wing currently maintains radar, telemetry, and command facilities. As a result, the Air Force will have to pay an estimated $350-400K per year for base support operations.

JOINT INTEROPERABILITY TEST COMMAND (JITC)

Defense Information Systems Agency (DISA)
Fort Huachuca, AZ/Indian Head, MD

KEY/UNIQUE AREAS OF CAPABILITY

JITC plans, conducts, evaluates, reports, and certifies the results of interoperability and other tests of information, communications, and intelligence hardware and software systems or elements.. It is the sole joint interoperability certifier for DoD. JITC offers complete systems testing with its one-of-a-kind array of hardware, software, and staffing and state-of-the-art technological flexibility. It operates a number of local/distributed test beds with an extensive network of military, commercial, and allied test facilities, interconnected by high-data-rate land circuits as well as radio and satellite links. JITC is also the Operational Test Agency (OTA) for DISA, and select programs for other agencies, such as, Defense Logistics Agency and Defense Finance and Accounting Service. JITC personnel provide real-time, on-site resolution of interoperability issues in CINC exercises and contingencies. Located at Fort Huachuca, Arizona, JITC is in a comparatively quiet and unrestricted electromagnetic environment. This unique location allows testing that cannot be performed elsewhere.

JITC's Joint Test Facility (JTF) operates a 16-acre test site with five test nodes. It tests every kind of transmission system including tactical line-of-sight, combat net radios; high-frequency microwave and tropospheric scatter systems; fiber optic cable; commercial telephone lines; and satellite links. It uses traffic and message loading devices to simulate high-volume conditions.

TESTING IN FY2000 (352 TEST PROGRAMS AND 736 WORKYEARS)

JITC testing extends from small standards conformance communications tests to major interoperability exercises and support of real world contingencies. During FY2000, JITC conducted over 100 interoperability tests and certifications and almost as many developmental and operational tests and evaluations or assessments. JITC personnel conducted 75 standards conformance tests/certifications as an important first step to achieving interoperability, and conducted about 30 performance and Y2K tests. JITC supports small standards conformance communications tests to major interoperability exercises and real world contingencies.

During FY2000, JITC conducted one of the largest DoD interoperability exercises occurred. The DoD Interoperability Communications Exercise (DICE 00) involved over 50 systems and 15 organizations distributed over a dozen locations. The exercise tested over 340 communications interfaces and identified many problems. JITC also supported Combined Endeavor, another exercise-based testing event focused on combined interoperability. As a Partnership for Peace initiative, it fostered interoperability among NATO, former Warsaw Pact nations, former Soviet Republics, and other members of the European Community. JITC provided primary technical support to U.S. European Command in planning, executing, and reporting on this annual interoperability event. Combined Endeavor 00 had personnel and equipment from 36 nations.

INFRASTRUCTURE OUTLOOK

New DoD initiatives, emphasizing testing for interoperability and information assurance, will cause an increase in workload as JITC's capabilities and facilities become more critical to achieving the Department's objectives. DoD acquisition programs have not fully utilized the capabilities of JITC, as the Services tend to conduct interoperability testing at their own sites using their own methodologies.

The CTEIP-funded Joint OT&E Simulation Environment Facility (JOSEF) provides JITC with a reusable capability providing an environment representative of warfare/contingency operations for OT&E of network-centric command, control, communications, computers, & intelligence systems. The JOSEF stimulates numerous users, which replaces the need for multiple human operators. It also provides a battlespace picture for tracking systems that removes the need for live interfacing platforms.

PART III

ARMY PROGRAMS

ABRAMS TANK (M1A2)

Army ACAT IC Program		**Prime Contractor**
Total Number of Systems:	1155	General Dynamics Land Systems
Total Program Cost (TY$):	$9976.3M	
Average Unit Cost (TY$):	$7.84M	
Full-rate production:	3QFY94	
SEP Production	4QFY99	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

Changes to the M1A2 Abrams Tank contained in the M1A2 System Enhancement Program (SEP), are intended to improve lethality, survivability, mobility, sustainability, and provide increased situational awareness and command & control enhancements to provide ***information superiority*** to the ***dominant maneuver*** force. The Abrams Tank and the Bradley Fighting Vehicle are two central components of the ***dominant maneuver*** digital force.

The mission of the M1A2 Abrams tank is to close with and destroy enemy forces using firepower, maneuver, and shock effect. The M1A2 is being fielded to armor battalions and cavalry squadrons of the heavy force. SEP upgrades are intended to:

- Improve target detection, recognition, and identification with the addition of two 2nd generation FLIRs.

- Incorporate an under armor auxiliary power unit to power the tank and sensor suites.

- Incorporate a thermal management system to provide crew and electronics cooling.

- Increase memory and processor speeds and provide full color map capability.

- Incorporate Force XXI Battle Command, Brigade and Below (FBCB2) Integrated Combat Command and Control (IC^3) to share battle command information and situational awareness with all components of the combined arms team.

In addition to the aforementioned SEP components, additional weight reduction measures, survivability enhancements, and safety improvements applied to the M1A2 will be incorporated into the configuration that will undergo LFT&E.

BACKGROUND INFORMATION

The M1A2 IOT&E was conducted from September-December 1993. Based on the results of the IOT&E, the Director determined that the M1A2 was operationally effective but not operationally suitable, and unsafe. That assessment was based on poor availability and reliability of the tank and instances of the uncommanded main gun and turret movement. FOT&E I was conducted September-October 1995 to verify corrective actions resulting from the IOT&E. This test was halted due to continued instances of uncommanded main gun and turret movements. FOT&E II in June 1996 confirmed the adequacy of the applied corrective actions and the M1A2 was assessed as both operationally effective and suitable.

The M1A2 SEP is a further upgrade to the M1A2 tank. OT conducted to date on the M1A2 SEP include a Detection, Acquisition, Recognition, Identification (DARI) test, conducted October-November 1998, and FOT&E III, conducted April-May 1999. The DARI was a side-by-side comparison between the M1A2 SEP equipped with 2nd generation FLIR and the baseline M1A1 equipped with a 1st generation FLIR. The results of the DARI demonstrated an improved capability of the 2nd generation FLIR over the 1st generation FLIR to detect, recognize, and identify targets at operationally relevant ranges. FOT&E III consisted of crew gunnery tables involving three M1A2 SEP tanks and four baseline M1A2 tanks. Its focus was to assess whether the M1A2 SEP possesses an increased capability over the baseline M1A2 to acquire, engage, and hit targets. During FOT&E III, the M1A2 SEP demonstrated a significantly better performance during night engagements over the baseline M1A2 in the number of targets hit as a percentage of the total number of target presentations. During day engagements, no performance difference was detected between the M1A2 SEP and the baseline M1A2.

The Director approved the M1A2 TEMP Update 3 in June 1999. This update included changes to the M1A2 SEP's T&E program necessary to address the system's incorporation of digital C^2.

The M1A2 SEP, along with the additional engineering changes included in the Abrams tank since 1993, sometimes referred to as the M1A2 Tank 2000, is considered a LFT&E "covered" product improvement requiring a LFT&E program with realistic vulnerability testing of full-up, combat configured vehicles. In July 1999, the Director approved an M1A2 Tank 2000 LFT&E strategy. This strategy includes a fourteen-shot, full-up, system-level live fire to be conducted between FY00-02.

TEST & EVALUATION ACTIVITY

No OT was conducted in FY00. FOT&E IV was conducted from October-November 2000 in conjunction with the BFVS-A3 IOT&E.

Most of the testing this year has been devoted to ensuring the M1A2 SEP will be ready for the FOT&E IV. Last year, the program modified its technical approach to integrating digital C^2. Much of the technical testing has focused on ensuring the successful integration of this new approach, called Integrated Combat Command and Control (IC^3). Software and C^2 performance testing was conducted in July 2000 at Aberdeen Proving Ground on the M1A2 SEP with IC^3. In addition, digital communications connectivity between the M1A2 SEP and BFVS-A3 was tested at the same time. Results of this testing were positive. Required digital messages were successfully transmitted between the two platforms and the M1A2 SEP's IC^3 demonstrated sufficient maturity to proceed to FOT&E IV.

Testing was also conducted this year to confirm fixes to the FLIR "washout" problem identified during FOT&E III. "Washout" caused by the main gun muzzle blast caused the FLIR to be ineffective for a short period after each main gun firing. Testing conducted in February 2000 substantiated the adequacy of these fixes, with FLIR performance comparable to the currently fielded M1A2.

Phase I LFT&E activities continued through FY00. Phase I addresses M1A2 SEP specific design features with component-level ballistic shock tests, non-destructive tests, and engineering analyses. Ballistic shock tests of the Commander's Independent Thermal Viewer with its 2nd generation FLIR and the Commander's Electronics Unit were conducted in May and June 2000. A production M1A2 SEP tank was also subjected to deliberate non-destructive electrical and electronic failures in a Controlled Damage Experiment conducted during the same time period.

The M1A2 LFT&E IPT continued to develop plans for the Phase III system level tests that are scheduled to begin in 1QFY01. The shotlines for two system-level and fourteen full-up system-level tests were selected by the IPT in January 2000.

TEST & EVALUATION ASSESSMENT

The integration of IC^3 has been the primary technical challenge to the program. IC^3 is designed to meet a key system requirement for digital battle command and is the M1A2 SEP link to FBCB2. A full evaluation of the M1A2 SEP requires that the system include functional, production-representative IC^3. Technical testing conducted on the M1A2 SEP indicated that the system's IC^3 was sufficiently mature to enter FOT&E IV and successfully demonstrate system digital C^2 requirements.

As noted above, the DARI test established the superiority of the M1A2 SEP 2nd generation FLIR's target acquisition capability in comparison to the currently fielded system.

The development of the Under Armor Auxiliary Power Unit (UAAPU) has proven to be a significant program challenge. The UAAPU is intended to provide auxiliary electrical and hydraulic power to the system during the conduct of mounted surveillance, thus reducing engine usage during tactical operations while improving operational fuel consumption rates. Engineering design problems encountered during developmental testing with the UAAPU have led the program to delete the UAAPU from the M1A2 SEP production configuration. The UAAPU remains an important system requirement, however the program is not currently funded to continue UAAPU development and the UAAPU is not currently included in the production configuration of this system.

During FOT&E III, as well as previous developmental testing, the thermal management system experienced a number of hydraulic leaks. The program office has instituted fixes to this problem, which were confirmed in DT and will be evaluated during FOT&E IV.

FOT&E IV, conducted in October-November 2000, consisted of 16 force-on-force battles between a M1A2 SEP/BFVS-A3 equipped company team and a baseline company team consisting of M1A2's and BFVS-A2's. This event, in which four M1A2 SEP's participated, was intended to evaluate the overall operational effectiveness and suitability of the M1A2 SEP. Results of FOT&E IV are not anticipated before January 2001. FOT&E IV was conducted with only the FBCB2 component of the Army Battle Command System (ABCS). M1A2 SEP-equipped units are scheduled to participate in future FBCB2 OT events, allowing for the opportunity for the M1A2 SEP to demonstrate full interoperability with the remaining components of ABCS.

ADVANCED FIELD ARTILLERY TACTICAL DATA SYSTEM (AFATDS)

Army ACAT II Program:		**Prime Contractor**
Total Number of Systems:	3,012	Raytheon
Total Program Cost (TY$):	$713.6M	
Average Unit Cost (TY$):	$160K	
Full-rate production:	1QFY96	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Advanced Field Artillery Tactical Data System (AFATDS) is a network of computer workstations that process and exchange information from the forward observer to the fire support element for all fire support assets (field artillery, mortars, close air support, naval gunfire, attack helicopters, and close air support). Features include the automatic processing of fire requests, generation of multiple tactical fire solutions for missions, monitoring of mission execution, and support for the creation and distribution of fire plans. AFATDS contributes to the ***Joint Vision 2020*** concept of ***precision engagement*** by providing responsive fire support command and control to tie together high fidelity target acquisition, prioritized target requirements, and joint forces within the battlespace. The Marine Corps have acquired AFATDS, which is one of the five battlefield functional areas comprising the Army Tactical Command and Control Systems.

BACKGROUND INFORMATION

AFATDS IOT&E, held in 1995 at Ft. Hood, TX, supported an assessment of operationally effective and operationally suitable for a Milestone III production decision. The AFATDS IOT&E

Verification Limited User Test (LUT), conducted in 1996, confirmed solutions for critical shortfalls, except for fire planning, where occasional fire mission deletions and system crashes were observed following transmission of the fire plan. Subsequently, AFATDS 96 software and Common Hardware System hardware entered full production and fielding. Fire planning, maximum fire-mission processing capacity, operators' ability to initialize the AFATDS data base, software reliability of multi-workstation nodes in operational conditions, and interoperability within the Army Tactical Command and Control System were all identified as issues of continuing interest for future testing.

AFATDS completed a LUT in October 1997, supporting a material release of AFATDS 97 software on newer Common Hardware System platforms. The first operational assessment of AFATDS involving Marine Corps units occurred at Twentynine Palms, CA, in March 1998. The tested hardware and software configurations did not support Marine Corps mobility requirements; however, the participating artillery units considered the automated support provided by AFATDS to be acceptable.

The AFATDS 98 LUT, a joint Marine Corps and Army event, was conducted in 1998 at Camp Pendelton, CA. The AFATDS 98 LUT examined AFATDS 98 software, the first version developed to address specific Marine Corps requirements, and provided theater level targeting and improved air support functionality. The AFATDS 98 LUT also examined several versions of hardware, including the Compact Computer Unit that reduces system size and weight. The AFATDS 98 "Fixes" LUT was conducted in 1999 in the Fire Support Test Directorate facility at Ft. Sill, OK. This test demonstrated solutions to deficiencies identified in the AFATDS 98 LUT and included air operations, Naval surface fire support, trigger events, fire planning, Multiple Launch Rocket System units, and attack aviation.

TEST & EVALUATION ACTIVITY

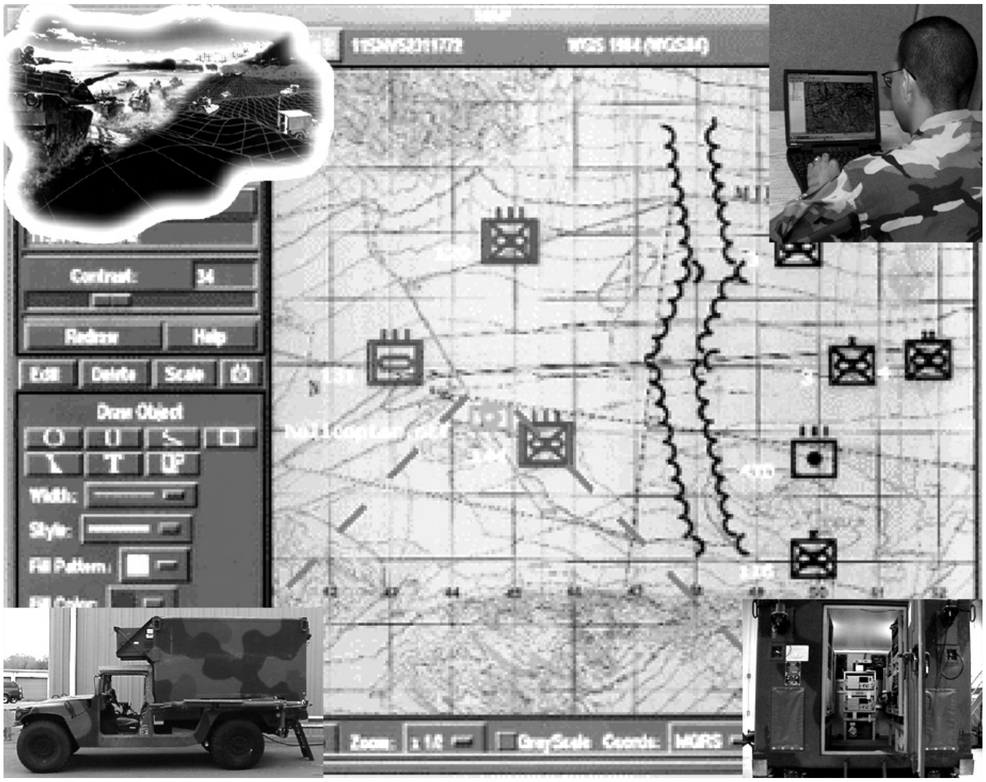
AFATDS test and evaluation activities during the past year have focused on planning for the integration of vertical fire support requirements existing within the fielded software (AFATDS 96, 97, and 98). Additionally, planning was also conducted for testing of the horizontal capabilities needed for AFATDS to be interoperable within the Army's First Digital Division. AFATDS 99 testing is scheduled to begin in 2QFY01.

TEST & EVALUATION ASSESSMENT

AFATDS IOT&E in 1995, along with AFATDS 96 software, established the core capability for this program. Initial functionality has been increased with testing and fielding of AFATDS 97 and AFATDS 98, and resolution of all identified problems has been demonstrated.

DOT&E continues to monitor AFATDS to determine the appropriate level of testing required to resolve issues of continuing interest. These issues include testing of future upgrades within the system-of-systems concept and interoperability with the Army Battle Command System as employed in the First Digital Division. AFATDS 99 software was to have been the first version to provide a common software baseline for both operational Army and Marine Corps units, as well as the Army's Digitization efforts; however, delays in the test and evaluation schedules for the Maneuver Control System and the Force XXI Battle Command Brigade and Below have resulted in horizontal functionality being deferred. Although a new TEMP has been prepared by the Army for AFATDS 99 testing, this document needs to be augmented with the AFATDS testing associated with Army Battle Command System Version 6 software.

ALL SOURCE ANALYSIS SYSTEM (ASAS)



Army ACAT II Program:

Total Number of Systems:	79 Block II ACE 1,031 RWS 1,477 ASAS Light 82 ACT-E 37 CCS
Total Program Cost (TY$):	$613M (FY99-FY05)
Cost Per Heavy Division (TY$):	$6M
Full-rate production:	FY03

Prime Contractor

Lockheed Martin Mission Systems
Austin Information Systems
Potomac Research, Inc.
Electronic Warfare Associates

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

Information superiority underpins the operational concepts outlined in ***Joint Vision 2020***. Intelligence provided by the All Source Analysis System (ASAS) allows commanders to identify key points for ***dominant maneuver*** and find high priority targets for ***precision targeting***. Accomplishment of these operational concepts supports attaining the ***Joint Vision 2020*** concepts of ***full spectrum dominanc***e and ***conduct of joint operations***. ASAS contributes to attaining information superiority through a network of computer workstations that process and exchange sensor data, fuse multi-source data into a single intelligence picture, and support management of intelligence sensors. ASAS is tactically deployable to support intelligence and electronic warfare operations at battalion through echelons above corps, and provides interoperability with joint intelligence and sensor systems.

BACKGROUND INFORMATION

The requirement for ASAS was approved initially in 1986. Subsequently, the requirements were structured so that the ASAS could be developed, acquired, and fielded in discrete increments or blocks. ASAS Block I successfully completed OT in 1993, and is fielded to selected theater, corps, and division units throughout the Army. The current development focus is on Block II. The Block II development is structured to attain an interim capability through a series of stand-alone products that can be tested and fielded as the overall development continues. The ASAS Block III is the objective capability. The ASAS Remote Workstation began fielding after completing its operational test program in March 1999. Another product, an upgrade to the Communications Control Set, obtained a conditional materiel release in June 1999 following a series of developmental tests.

TEST & EVALUATION ACTIVITY

The Test and Evaluation Master Plan for the ASAS Block II program was updated to more accurately reflect ASAS Block II development. This TEMP completed an intensive integrated product team process leading to OSD approval in August 2000.

The Analysis Control Team Enclave (ACT-E), a Warfighter Rapid Acquisition Program initiative, is a shelter mounted on a High Mobility Multipurpose Wheeled Vehicle that integrates the ASAS Remote Workstations used by the brigade ACT with networking capabilities, radios, and other supporting equipment. The integrated shelter facilitates set-up/tear down, integration of information, and provides environmental protection for the computer equipment and a work area for the operators. The ACT-E is the integrating focal point for intelligence surveillance and reconnaissance management within the maneuver brigade. The ACT-E completed a test program that resulted in a successful In-Process Review in September 2000 for acquisition and fielding. The test program included Factory Acceptance Tests and a logistics demonstration at Vint Hill Farms, technical tests at the Central Technical Support Facility and the Aberdeen Test Center, and a Limited User test at the Pinon Canyon Maneuver Area.

The ASAS Light, a laptop providing a sub-set of Remote Workstation functionality to the intelligence sections at the maneuver battalions, completed developmental testing in May 2000. The two-phase operational test program included a controlled event in August 2000 at the Central Technical Support Facility focusing on ASAS Light functionality and a field training exercise in October 2000 focusing on the operational integration and contributions of the ASAS Light to the battalion intelligence staff.

Planning continues for remaining ASAS Block II products. The focus for 2001 is testing of the ASAS Remote Workstation implementing the Army Battle Command System Version 6 software. Planning also continues for the FY02 Analysis and Control Element operational test that will serve as an IOT&E for the ASAS Block II and support a Milestone III production decision.

TEST & EVALUATION ASSESSMENT

ACT-E is a unique product within the ASAS family as it is a shelter housing existing computer hardware and software. The integration of existing components into a single shelter supported the ACT staff in their operations. Further, the ASAS Remote Workstations supporting the ACT mission operated with no apparent degradation of their inherent functions and capability. ACT-E demonstrated acceptable reliability and logistics support. Consequently, ACT-E was assessed as operationally effective and operationally suitable to support a positive In-Process Review and conditional materiel release. The conditions result from three of the integrated systems having conditional materiel releases: the ASAS Remote Workstation, the Quick Erect Antenna Mast, and the High Mobility Multi-Wheeled Vehicle Model 1097 A4.

ASAS Light completed a two-phase Limited User Test to support an In-Process Review scheduled for mid-FY01. The conclusive evaluation of ASAS Light performance is ongoing as of the publication date of this Annual Report. However, we observed significant problems in establishing digital connectivity between the ASAS devices at brigade with those in the two battalions in the second phase of the Limited User Test. Issues included hardware problems at brigade, one battalion exceeding typical communications ranges, and the other battalion having network-addressing issues. ASAS Light was not well integrated into the unit's operations and did not contribute greatly to their execution of the firefight. ASAS Light was of more value in the preparatory phases of intelligence preparation of the battlefield and planning. The tests also identified general concerns with functionality and interoperability, many of which are related to the migration towards interoperability through the standardized software of the mandated Common Operating Environment. ASAS Light using Microsoft Windows NT further complicates the process because Common Operating Environment software applications typically are developed on Unix-based workstations. While envisioned as eventually being beneficial, the migration is causing problems for programs such as ASAS, which are currently fielded because the Common Operating Environment applications often provide less capability than and are not fully backwards compatible with fielded software. For example, implementing the newer Military Standard 2525 symbols in the Joint Mapping Tool Kit complicates exchange of overlays with fielded systems using a different graphics standard. These concerns complicate decisions to field newer systems such as ASAS Light and the new version of the ASAS Remote Workstation.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

ASAS Light testing confirmed the value of information obtained by carefully combining testing with training events. The information obtained from the ASAS Light October 2000 field-training exercise is proving invaluable to the evaluation. Careful planning and focused data collection are necessary prerequisites for successfully combining testing and training.

ASAS operational tests highlighted the challenges of integrating automation into field units. The ability of computers to rapidly gather and access large quantities of information places increasing emphasis on the analytical skills and experience of the operators. Realizing the potential benefits from these systems requires operators with strong intelligence analysis skills and staffs that thoroughly understand how to integrate automation into intelligence processes. Classroom training alone is proving insufficient and no substitute for operational experience. Acquiring this experience requires opportunities to operate with actual sensors and staffs or the development of realistic embedded training and simulations.

The pace of technological change during software development essentially dictates that computer hardware not be procured until absolutely necessary. Funding to procure laptop computers for ASAS Light was available and computers procured for eventual fielding months before ASAS Light entered testing. Software growth and performance caused the program to upgrade the computer configurations before the test program was completed. Further, the early availability of hardware often leads to its distribution and de facto fielding for "experimentation" purposes. Although hardware is typically presented as a low-cost and risk item, oversight agencies should carefully monitor and program offices should report hardware procurements for systems that are in software development to avoid unnecessary costs and unauthorized fielding.

ARMY MULTIFUNCTIONAL INFORMATION DISTRIBUTION SYSTEM-LOW VOLUME TERMINAL 2 (MIDS-LVT 2)

Joint ACAT ID Program (Navy Lead)

Total Number of Systems:	87+
Total Program Cost (TY$):	$100
Average Unit Cost (TY$):	$273
Low-Rate Initial Production:	3QFY00
Full-rate production:	3QFY02
Limited User Test (LUT)	1QFY00
Initial Operational Test and Evaluation (IOT&E):	2QFY02

Prime Contractor

Terminal Production: MIDSCO
Production: Viasat

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Army Multifunctional Information Distribution System-Low Volume Terminal 2 (MIDS-LVT 2) provides Link 16 digital data communications to Air and Theater Missile Defense Command and Control (C^2) host systems, providing a ***common relevant operational picture*** of theater air activity. Link 16 provides a robust and jam-resistant network for **Joint and Multinational Force** data sharing. The early warning and air track identification information provided by Joint sensor and C^2 platforms supports the coordination of long-range ***precision engagement*** fires, safe passage zones, and near real-time warnings of impending air attack—contributing to ***full-dimensional protection***. The air surveillance and weapons coordination engagement options provided by Link 16 implementation enables ***synchronized operations*** and employment of ***correct weapons*** for each target to generate the desired results. Engagement intentions and results assessments are shared by all network participants, contributing to improved ***decision making*** by the Battle Commanders. The MIDS-LVT 2 terminal plans to share a number of common components with the Navy's MIDS-LVT 1 and Air Force F-15 Fighter Data Link terminals, providing a significantly improved level of ***sustainment interoperability***.

The Army MIDS System includes the MIDS-LVT 2 terminal, the Joint Tactical Information Distribution System (JTIDS)/MIDS-LVT 2 Terminal Controller, the JTIDS/MIDS antenna, and the host platform interface software and displays. The JTIDS/MIDS Terminal Controller consists of specialized software hosted on a Pentium-chip ruggedized personal computer that provides initialization and status monitoring functions.

Planned Army MIDS-LVT 2 host platforms include the PATRIOT Information and Coordination Central (ICC), the PATRIOT Battery Command Post (BCP), the Theater High Altitude Air Defense (THAAD), the Joint Land Attack Cruise Missile Elevated Netted Sensor (JLENS) system, and the Medium Extended Air Defense System (MEADS).

BACKGROUND INFORMATION

The Army developed the Link 16 capable JTIDS Class 2M terminal and procured 69 production units. These units have been fielded to the Forward Area Air Defense Command and Control (FAAD C^2), PATRIOT ICCs, and Joint Tactical Ground Stations (JTAGS). Other terminals have been delivered for near-term fielding to Air Defense Artillery Tactical Operations Centers (ADA TOCs) and to THAAD for integration engineering. The Army decided to conclude acquisition of the Class 2M and transition Link 16 requirements to MIDS in FY99, and plans to satisfy the remaining host platforms' Link 16 requirements with MIDS-LVT 2.

The Army MIDS-LVT 2 uses a number of common components designed by the international MIDSCO consortium; however, MIDS-LVT 2 does not have all the functionality of the MIDS-LVT 1 terminal. For example, MIDS-LVT 2 does not have Link 16 digital voice, Tactical Air Navigation, and has only one Receiver/Synthesizer (R/S) card instead of the MIDS-LVT 1's two R/S cards. However, MIDS-LVT 2 has unique data exchange protocol interfaces, ground power supply, and a cooling unit to support field deployment and operation.

The Army executed a Low Rate Initial Production (LRIP) buy during 3QFY00, in conjunction with the Defense Acquisition Board's approval of the overall MIDS-LVT LRIP Lot 1 acquisition. These MIDS-LVT 2 terminals will support host platform integration engineering and IOT&E scheduled for 2QFY02. Following successful IOT&E, a MIDS-LVT 2 full-rate production decision is planned for 3QFY02.

TEST & EVALUATION ACTIVITY

Testing for FY00 included both DT and OT events. A draft Army Annex to the MIDS-LVT Capstone Test and Evaluation Master Plan was developed by the Army MIDS-LVT 2 developer, Program Manager-Tactical Radio Communications Systems (PM-TRCS), and submitted to DOT&E during July 1999.

The Army Air Defense Artillery Test Directorate of the Operational Test Command conducted a Limited User Test (LUT) at Eglin AFB, FL, ranges from September 21-October 7, 1999. The objective of the LUT was to examine selected capabilities of Army MIDS in a joint environment. The LUT leveraged resources from the Air Force's F-15 Fighter Data Link (FDL) Electronic Warfare (EW) Combined Developmental Test/Operational Test and Multi-Service Operational Test (MS-OT).

For the LUT, the systems under test were two Army hosts equipped with EMD MIDS-LVT 2 terminals—these were the PATRIOT ICC and the Short Range Air Defense (SHORAD) FAAD C^2.

Other LUT Link 16 network participants were a JTIDS Class 2M equipped FAAD C2, a JTIDS Class 2H (High Power) E-3 Airborne Warning and Control System (AWACS), a JTIDS Class 2 equipped Control and Reporting Center, a Class 2 equipped F-15C/D fighter aircraft, and a FDL equipped F-15E air interdiction fighter aircraft. In addition, BIG CROW ground-based and airborne jamming systems participated, targeting FDL equipped F-15E's Link 16 communications. No EW testing was accomplished by Army systems during this event.

The Army MIDS-LVT 2 developer, PM-TRCS, completed a Logistics Demonstration (Log Demo) and a Maintenance Demonstration (M-Demo) at the contractor facility during October 1999. The objective of the two demonstrations was to evaluate maintainability goals and time standards, adequacy and suitability of tools and technical publications, Built-In Test (BIT), and allocation of logistics support and maintenance tasks.

The Log Demo was a simulated demonstration of the Organizational (O) and Intermediate (I) Level maintenance tasks. The tasks were performed in accordance with the Technical Manuals (TMs) and validated the repair times in the Maintenance Allocation Chart. Additional data was used to validate the remainder of the TMs and the tools required for maintaining MIDS-LVT2. The Radio Repair Soldier also performed a series of O and I Level maintenance tasks while outfitted in Mission Oriented Protective Posture gear.

The M-Demo was a timed demonstration of MIDS-LVT 2 Operator and Maintainer tasks using fault insertion. The maintenance tasks of fault detection and isolation were performed in accordance with the TM. Direct Support Level maintenance tasks of removing and replacing Line and Shop Replaceable Units (LRU/SRUs) were demonstrated, as were the O Level maintenance tasks of battery and air filter replacement.

The Electronic Proving Ground (EPG) independent evaluators recorded the results of the demonstrations. Both USD (A,T&L) DT&E and DOT&E representatives were permitted to observe the demonstrations. The Logistics Demonstration and M-Demo Reports were submitted to DOT&E for review.

PM-TRCS has also started reliability testing on EMD terminals as a risk-reduction toward production. The test is planned to use up to two EMD MIDS-LVT 2 terminals, operating them in an environmental chamber while operating in a network with message exchange for a total of 5,000 hours. The Army Communications Electronics Command test chambers will be used for the test. A reliability test will be conducted with LRIP terminals when they become available.

TEST & EVALUATION ASSESSMENT

The Limited User Test (LUT) scenario is planned to evaluate the contribution of Link 16/MIDS LVT 2 in defending a Joint Engagement Zone (JEZ) against the threat aircraft. This required close coordination between Air Force C^2 and Army C^2, as well as the fighters within the JEZ to prevent fratricide and de-conflict their simulated engagement of the adversaries.

The Army was able to complete two days of pilot trials and two days of record tests of the LUT in a benign (non-communications jamming) environment. Based on the BIT anomalies and related performance issues, a decision was made to defer testing in an Electronic Warfare environment.

During portions of all four days, the Army MIDS-LVT 2 and JTIDS Class 2M equipped systems participated on the Link 16 network with Air Force Link 16 host platforms and exchanged air surveillance, track identification, participant identification and location, and engagement status messages demonstrating a basic level of Joint Interoperability in an operationally realistic scenario. The E-3 AWACS also transmitted one weapons control order, "Weapons Tight" to the PATRIOT ICC. This command was successfully received and correctly displayed. Unfortunately, due to data recording problems Link 16 message data was not available, therefore message success rate analyses could not be completed.

The combination of insufficient operating hours and the loss of corroborating prevented the completion of MS-OT for Army MIDS and the evaluation of Link 16's integration impact on the Air Defense Artillery mission area; i.e., quantitative improvement in coordination of fires, reduction of fratricide, etc. These objectives will be addressed in later testing.

The LUT identified a number of Army MIDS technical and operational deficiencies:

- Initially, the Joint Link 16 network was incompatible with Army systems and the network required a workaround re-design before network entry could be achieved.

- The JTIDS network was not designed to display connectivity status, thereby not allowing Army JTIDS/MIDS operators to view the status of the overall Link 16 network.

- The transfer of Link 16 data from the MIDS-LVT 2 terminals to the host stopped after a few hours of nominal operation on both record test days. This was later discovered to be an erroneous Built-In Test indication that stopped message processing.

- There were three Army Link 16 network synchronization difficulties. These were resolved by replacing the receiver/transmitter card in the PATRIOT ICC MIDS-LVT 2 terminal; extending the height of the Link 16 antenna mast to achieve line-of-sight with the CRC when AWACS was not in the network; and correcting an operator error in FAAD C^2.

- While the training program adequately prepared the soldiers to operate the terminal, there were differences in the test terminal and network design, which ultimately required an additional instruction period to train to these differences.

PM-TRCS is implementing solutions for all of the technical hardware and software issues. The Army Signal Center has acknowledged that the training course will be improved for IOT&E. Insufficient operating time prevented the completion of the evaluation of Link 16 effectiveness contribution to the theater air and missile defense mission areas.

The Logistics and Maintenance demos demonstrated that maintainability goals were achievable. The soldier was able to use the BIT, technical publications, and tools to meet the Mean Time To Repair requirement of 30 minutes. The MIDS-LVT 2 Direct Support maintenance tools were determined to be common and suitable. In contrast to earlier Contractor Developmental Test and Evaluation results, the BIT appeared significantly improved. Fifty faults were inserted and all fifty were detected correctly (100 percent fault detection against a 98 percent detection requirement). The 95 percent criteria was met for isolating faults to one of one SRU, and the 98 percent criteria was met for isolating faults to one of three SRUs. The Logistics Demonstration and M-Demo did find a small number of hardware, software, and publications issues that were either deficient, immature, or considerations for enhancement.

The reliability test start has been delayed to allow the contractor an opportunity to troubleshoot the resolution of a cold temperature issue between the Power Amplifier and the Power Supply Assembly. Test completion is expected during 3QFY01.

CONCLUSIONS AND RECOMMENDATIONS

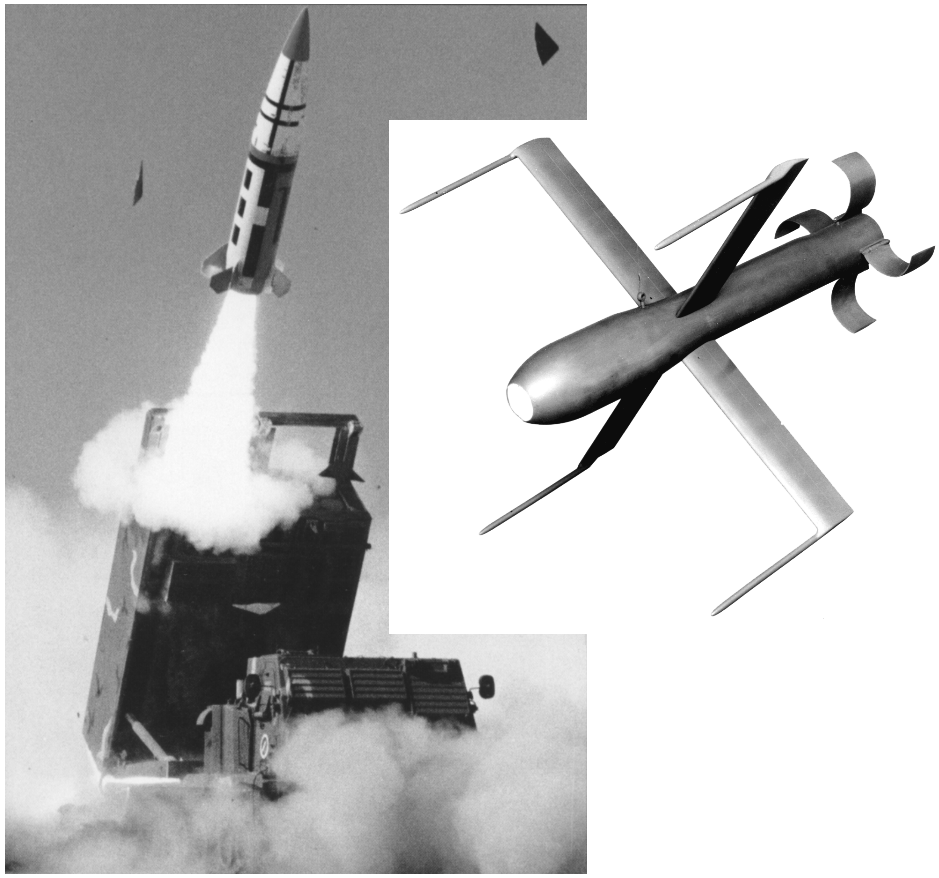
Army MIDS-LVT 2 evaluations completed during FY00 provided valuable and early insight into the maturity of Army MIDS and integration into the PATRIOT ICC host platform. The presence of PM-TRCS at the LUT facilitated his recognition of the deficiencies and the attendant operational impacts. While not interfering with the Operational Tester conduct of the evaluation, the developer was able to perform some troubleshooting, initiate mitigation, and re-design resolution before the LUT was terminated.

In order for an adequate test, IOT&E should evaluate the integration of Army MIDS into host platforms other than the PATRIOT ICC since that platform will receive the least quantity of MIDS-LVT 2 terminals, participated in the LUT, and has already completed JTIDS integration. Host platforms such as the PATRIOT BCP or THAAD should be considered for test and evaluation of the operational effectiveness and operational suitability of MIDS integration.

A test and evaluation event, with appropriate Operational Tester participation to evaluate LUT deficiency resolution, must be scheduled for early FY01.

Continuing emphasis must be placed on training. Operation within a Link 16 network is fairly complex and requires comprehensive sustainment training for the operators/maintainers to maintain their skills. While the Army LUT demonstrated a fair level of operator training, it did indicate some shortfalls in the areas of network monitoring and troubleshooting. Evaluations of other Service operations have also identified training area deficiencies. These include operators that are not able to correctly initialize their terminal or host platform or enter the Link 16 network; incorrectly loading crypto-variables and not recognizing or properly reacting to Interference Protection Feature alerts or other fault indications. In general, Link 16 operators are not afforded adequate practice with the actual hardware and software they will operate in the tests or the field.

ARMY TACTICAL MISSILE SYSTEM (ATACMS) BLOCK II



Army ACAT ID Program		Prime Contractor
Total Number of BATs:	11,965	Northrop Grumman Electronic Systems
(3,487 BAT + 8,478 P^{3}I BAT)		(BAT submunition)
Total Number of Missiles:	919	Lockheed Martin Missiles and Fire Control - Dallas
Total Program Cost (TY$):	$3,238.8M	(Block II Missile)
Average Unit Cost (TY$):	$3.524M	
Full-rate production Decision:	4QFY02	
P^{3}I BAT Cut-In Decision	4QFY02	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Army Tactical Missile System (Army TACMS) Block II/ BAT and Army TACMS Block II/ P^{3}I BAT systems are ***precision engagement*** weapons that integrate stand-off delivery accuracy with a submunition possessing the required capability to autonomously seek and kill moving and stationary armor in the deep battle zone. This ***precision engagement*** capability is designed to enable joint U.S. and combined allied forces interdiction of enemy formations through synchronized operations from dispersed locations. This ability to engage deep targets will contribute to the joint effort that *ensures* ***dominant maneuver***.

BAT is a self-guided submunition that uses on-board sensors to seek, identify, and engage enemy combat vehicles. Thirteen BATs are dispensed from the Army TACMS Block II missile. The Army is developing two BAT variants. Basic BAT variant will engage moving armored vehicles using acoustic and infrared sensors. The acoustic sensor acquires and guides the submunition to the moving vehicles. Once in the vicinity of a threat vehicle, the infrared sensor guides the BAT to its aimpoint, where it uses a tandem-shaped warhead to destroy the vehicle.

P^3I BAT variant is designed to attack moving and stationary armor as well as transporter-erector-launchers (TEL) and multiple rocket launchers (MRL). As with the Basic BAT, P^3I BAT will use acoustic sensors to initially acquire moving vehicles. Once acquired by the acoustic sensor, the P^3I BAT uses its millimeter wave and imaging infrared sensor to track the target to impact. When the system engages stationary targets (armored vehicles and TELs and MRLs), the P^3I BAT will use its millimeter wave and imaging infrared sensors to detect, acquire, and track a target to impact.

BACKGROUND INFORMATION

Both Army TACMS Block II and Basic BAT were approved to enter low-rate production in February 1999. Formal LFT of the Basic BAT will be conducted from August 2000-February 2001. Army TACMS Block II/BAT will be operationally tested from May-August 2001, and will enter full-rate production in July 2002.

The P^3I BAT began continued development in July 1999. A DAB decision to change production from Basic BAT to P^3I BAT will be made in July 2002. Hard target live fire testing for P^3I BAT is currently planned for 1QFY02, and soft target live fire testing is planned for 1-3QFY04. The Army TACMS Block II/ P^3I BAT continued production decision will be made in 2QFY05, after a Limited User Test (LUT) and evaluation. The LUT will be fully operationally representative.

TEST & EVALUATION ACTIVITY

An operational test of the command and control architecture was completed in May 2000. The test included a Common Ground Station (CGS) that used simulated Joint Surveillance and Targeting System (JSTARS) information, as well as field artillery elements from corps to launcher.

Technical testing for the past three years has focused on missile firings of the Army TACMS Block II/BAT and demonstrating submunition reliability fixes. There have been 10 flight tests with 66 functional BATs against a moving array of real armored vehicles and five single-submunition drop tests. Tests were against clean and countermeasured vehicles with intentional aimpoint offsets replicating errors in target location. Three of the tests used full-up missiles with 13 functional BATs. All testing has been consistent with the DOT&E-approved TEMP. DOT&E and Army OTA representatives have observed all flight tests.

A variety of Basic BAT LFT&E activities were conducted in FY00. Warhead fragmentation and behind armor debris characterization tests were completed in February 2000. The first BAT LFT shot was conducted in September 2000; seven Basic BAT rail shots against a T-72 tank are expected to be completed by February 2001.

P^3I BAT conducted two preliminary captive flight tests to collect target signatures and develop submunition algorithms. During the months of May-August 2000, the P^3I BAT contractor conducted the first series of Recoverable BAT (RBAT) submunition flight tests at White Sands Missile Range. RBATs have similar hardware and algorithm as the P^3I BAT, except when an RBAT locks onto a target, it is programmed to track momentarily and then deploy an additional parachute so that it can be recovered. In this way, multiple tests can be conducted with the same hardware. The first RBAT series tested recovery techniques and P^3I BAT's unique flight profiles. RBAT-1 did not have the dual mode seeker. Future RBAT series (three in all) will have the dual mode seeker. P^3I BAT LFT&E activities were also initiated in 4QFY00, with the completion of seeker simulant validation testing. The 12-shot warhead performance verification tests (PVT) are scheduled to be completed by December 2000. DOT&E is working with the Army to develop a robust test and evaluation strategy (both OT&E and LFT&E) for Army TACMS Block II/ P3I BAT, which will be included in an updated TEMP.

TEST & EVALUATION ASSESSMENT

Functional reliability of the components that make up the BAT submunition, performance against countermeasured targets, and system targeting are areas of concern. Accuracy and command and control tactics have been adequately demonstrated thus far in the program.

Last year's missile firings indicate that the missile will meet its accuracy requirement. In addition, 89 percent (115/130) of the BATs were successfully dispensed. However, one full-up missile damaged nine of the 13 BATs in the dispense phase of the flight. The missile problem was identified and a fix incorporated into the production design. The one missile flight conducted after incorporating the fix did not appear to have any dispense problems.

BAT submunition reliability is not currently meeting the ORD reliability threshold. A BAT is scored reliable if it functioned as designed. Reliability is a measure of hardware and software reliability, not mission effectiveness or the ability of the software to find targets. A reliable BAT can miss the target. In 1998 and 1999 EMD tests, 80 percent (32/40) of the submunitions successfully dispensed from missiles were reliable. The Milestone III requirement is 91 percent. Fixes for most of the reliability problems have been included in the production design. Due to production problems, there has been limited testing to date of the new production design. This year, six single-BAT drop tests from a Cessna and one missile firing were completed. One of the drop tests was not successfully executed. Three of the five successfully dropped BATs (60 percent) were reliable. Of the three reliable BATs: one hit a surrogate target; one hit a countermeasured BMP, and one missed (by less than one meter) a countermeasured tank. One unreliable BAT did not deploy its wings and the other one did not detonate its warhead, although it hit an uncountermeasured tank. During an August 2000 full-up missile firing carrying 13 BATs, a 77 percent reliability was achieved (10/13). Of the ten reliable BATs, eight BATs hit targets (five tanks, two infantry fighting vehicles, and one howitzer), one BAT hit the target track, and one either hit or near missed the howitzer noted above. The three unreliable BATs exploded in mid-air. This failure mode had occurred previously in EMD testing and a "fix" had been implemented. The contractor and PM believe the most recent mid-air explosions are the result of a different failure mode. In addition, during this investigation, the contractor identified the most probable cause for the non-detonating warhead in the drop test. A fix has been identified and technical testing will verify the fix before entering the operational testing planned for 2001.

There have also been problems with the Inertial Measurement Unit (IMU). While there have not been failures in the recent tests due to the IMU, some BATs with faulty IMUs have been rejected at various points in the production process. The contractor has identified a fix for this problem. The new design will be validated through technical testing and included in the May 2001 operational flight test. In addition, a new IMU will be included in the base BAT production line sometime after the production decision.

The Army recently contracted an independent panel to do a quick review of the BAT program. The panel found major issues in several areas including seeker and IMU reliability, as well as program, quality, producibility, and schedule problems. The project office is currently implementing the panel's recommendations.

It is unlikely that BAT will meet its 91 percent reliability requirement during OT because a test-fix-test reliability growth program was not implemented in the EMD technical tests. In addition, the production facilities were moved recently, which is partially responsible for production delays and may also increase OT reliability problems. However, computer simulation predicts BAT can meet most of its requirements with a lower submunition reliability.

However, to date, limited testing has been conducted on the recently approved Defense Intelligence Agency (DIA) countermeasures. Four of the single-BAT drop tests were tested with countermeasures. The OT will include four missions (five missiles) against the DIA-approved countermeasures. BAT's effectiveness against the most likely countermeasures will be unknown until completion of the OT.

The LFT&E strategy for the weapon system was developed to take advantage of expected hits on armored vehicles during the planned flight tests of Basic BAT submunitions with live warheads. There have been 22 BAT drops/dispenses with live warheads that have been scored to date; seven of these have hit targets (both tanks and light armored vehicles). One of the warhead hits did not detonate the warhead. These test results, along with the detailed lethality results from the 7 shots against a T-72 tank in dedicated LFT, will provide sufficient data to determine that the Basic BAT submunition can meet its lethality requirements given a hit against moving armored vehicles.

As part of Block II/BAT's total system evaluation, a command and control operational test was completed in May 2000. This test examined the ability of the Army's command and control system to track and target large armored columns. The operational test showed that the Army can produce targeting errors that are within Block II/BAT's stated operating parameters. Block II/BAT's ability to overcome these operational errors will be demonstrated in upcoming operational flights.

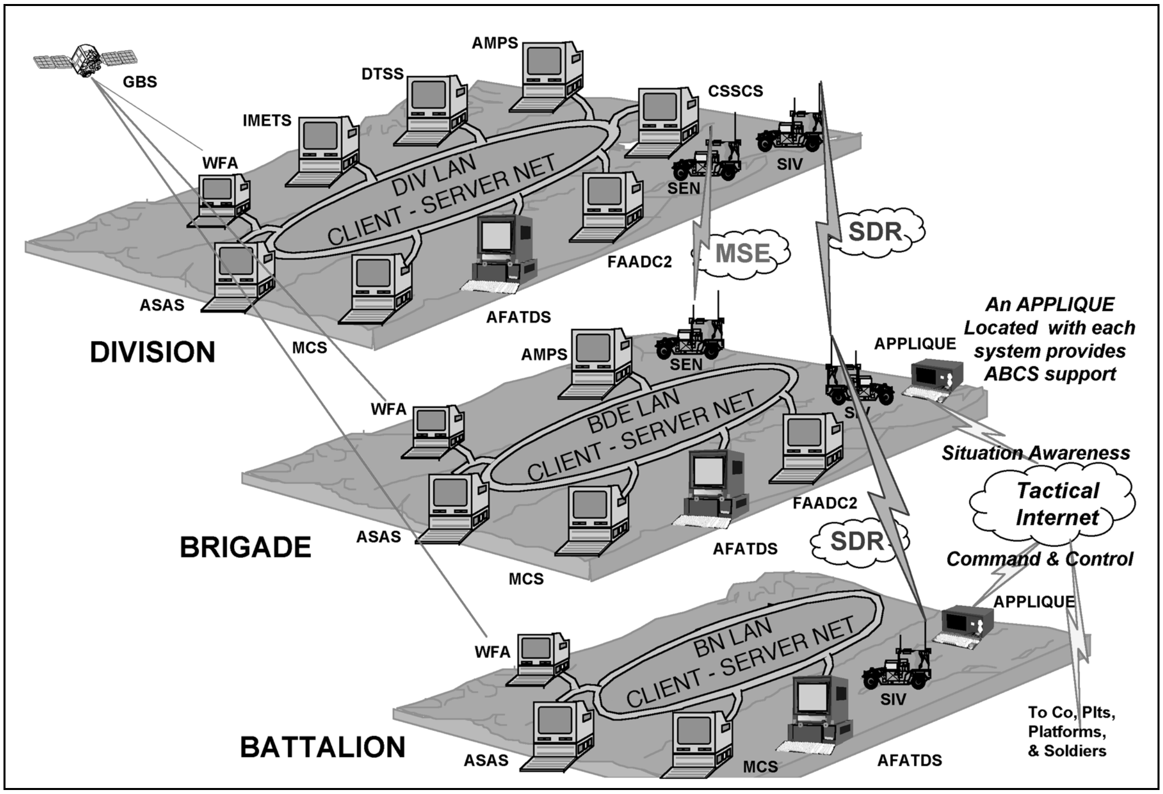
The ability to find and locate Block II/BAT targets is an area of concern. JSTARS is the only currently available and viable targeting source for Army TACMS Block II/BAT's target set of armored columns moving deep in the battlefield. The Army conducted a technical demonstration of JSTARS' ability to acquire Army TACMS Block II/BAT targets. The demonstration showed that if JSTARS is available, it is capable of producing accurate and timely data in flat terrain with little radar clutter and no extraneous targets. However, for reliability reasons, JSTARS was not able to provide any targeting information for half of the three days of testing. This, combined with other DOT&E JSTARS experience, makes it questionable whether JSTARS will be available consistently to provide Block II/BAT targeting information.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

The Army TACMS Block II/BAT Program has incorporated early and continued OT&E involvement during DT and the attendant modeling and simulation plan. Each test event has significantly contributed to the body of knowledge regarding the Army TACMS Block II missile and builds toward eventual ATEC accreditation of the IOT&E simulation strategy. This early involvement, combined DT/OT strategy, and robust modeling and simulation, has been key to the evaluation strategies for both the developer and operational testers.

System reliability, however, has been less remarkable. In 1997, a decision was made by the program to forego a test-fix-test approach in developing this system. While there are potential costs and time expenses in a test-fix-test strategy, there are clear advantages in developing a more reliable system over time. The most recent problems and required fixes to those problems BAT has been compelled to make have resulted in a *de facto* test-fix-test environment that, ironically, may benefit the system in the long run.

BATTLEFIELD DIGITIZATION



DIGITIZATION DESCRIPTION AND CONTRIBUTION TO JOINT VISION 2020

Battlefield digitization is viewed by the Army as the essential enabler that will provide ***information superiority*** on the tactical battlefield. Battlefield Digitization is intended to support the ***Joint Vision 2020*** concepts of ***dominant maneuver, precision engagement, focused logistics***, and ***full-dimensional protection*** via improved command and control. Components of Battlefield Digitization include the computers, routers, and radios that comprise a vast network extending vertically from Corps down to individual platforms, and horizontally across all combined arms elements of the force. It can be decomposed into two major sub-networks: the lower Tactical Internet which encompasses the weapons platforms and vehicles (with their associated command, control, and communications systems), and the upper Tactical Internet which links the Tactical Operations Centers (TOCs) of the force from battalion through corps.

DOT&E currently performs oversight on many of the individual systems comprising Battlefield Digitization. Oversight systems that will operate on the lower Tactical Internet include Force XXI Battle Command, Brigade and Below (FBCB2) computers and software, the Enhanced Position Location Reporting System (EPLRS), and the Single Channel Ground and Airborne Radio System (SINCGARS) and Internet Controller. Oversight systems that will operate within the upper Tactical Internet include the Army Tactical Command and Control System (ATCCS) components (MCS, ASAS, AFATDS, CSSCS, and FAAD C^3I) and the Mobile Subscriber and Near-Term Data Radio communication systems. The Joint Tactical Radio System (JTRS) is expected to replace the Near-Term Data Radio, SINCGARS, and EPLRS when it enters service, and will be a key element of the Warfighters Information Network-Tactical (WIN-T). The Command and Control Vehicle (C2V) was to be the vehicular shelter that housed many of the upper Tactical Internet components, however, the Army terminated this program during FY00. "Embedded Digital Platforms" include the M2A3 Bradley Fighting Vehicle and the M1A2 Abrams Tank System Enhancement Program. Each of the underlined systems is fully addressed in a separate section of the Annual Report, alphabetized under "Army Systems."

BACKGROUND INFORMATION

The Army initiated the Force XXI Battlefield Digitization program in 1994, with the intent to proliferate and integrate digital communications and information management technologies across the combined arms spectrum. The Army's efforts have been demonstrated in a series of Advanced Warfighting Experiments (AWEs), where the hypothesis: "If information age, battle-command capabilities and connectivity exist across all battlefield operating systems, then increases in lethality, survivability, and op tempo will be achieved," has been examined. Although neither the antecedent nor the consequence of this hypothesis has been observed to date, the Army has accelerated the delivery of digital technologies to operational users and reduced the number of maneuver companies in each heavy division by 25 percent.

The Task Force XXI AWE equipped a brigade from the 4th Infantry Division with Army Tactical Command and Control Systems in its Tactical Operations Centers and Appliqué hardware and software on all of its 800-plus vehicles. The brigade trained with the new digital equipment and supporting communication systems among dozens of other initiatives for about eight months, then deployed to the National Training Center for a series of force-on-force battles with a live opposing force. Due to immaturity and limited interoperability of most of the digital equipment, the degree of digital connectivity achieved during the Task Force XXI AWE was not sufficient to meet the premise of the central hypothesis and was unsuitable for tactical operations. This immaturity also impacted the training readiness of the unit and the development of Digital Tactics, Techniques, and Procedures (TTPs).

MCS IOT&E and the 1998 FBCB2 LUT-1 demonstrated progress towards the Army's Digitization goals, but were limited in scope and size. The friendly situational awareness information observed during the FBCB2 LUT-1 was generally accurate and timely for the participating battalion task force, and the improved system stability permitted soldiers to employ this information during execution of their missions. The stability also permitted the test unit to achieve a higher state of training than the Task Force XXI unit, and furthered the refinement of Digital TTPs. MCS IOT&E demonstrated improved functionality within and between MCS systems, but interoperability with other command and control systems was inadequate and resulted in data base inaccuracies and poor user acceptance, especially at the lower echelons (battalion). Displacement of division-level TOCs did not occur, and the logistical supportability of MCS in the tactical environment was not adequately demonstrated.

In FY99, Army Battle Command System (ABCS) Version 6 software development was accelerated to bring new and common functionalities across the ATCCS systems. The new capabilities will include the TOC Server and the Joint Common Data Base, which together promise new levels of interoperability for the Digital Battlefield within the Defense Information Infrastructure Common Operating Environment. The first look at ABCS 6.0 occurred in conjunction with the FBCB2 Force Development Test and Experiment (FDTE)/Customer Test (CT) in April 2000, where performance of FBCB2 and ABCS systems were to be examined, and critical TTPs for the Digital Battlefield were to be validated.

The FBCB2 FDTE/CT was the first effort to fully integrate ATCCS with FBCB2, and the upper and lower Tactical Internets, in an operational test. The developmental test, which preceded the CT, was never successfully completed, and the operational test was downgraded by the Army from the originally planned LUT-2 to the CT when it became apparent that the entrance criteria for the LUT-2 could not be met. The primary reason for cancellation of LUT-2 was immaturity of the ABCS 6.0 software, which lacked critical functionality and was unstable during the developmental test. These shortfalls with ABCS software continued during the FDTE/CT, and the ABCS software was not operationally useful to the test unit. The performance of the FBCB2 component in the lower Tactical Internet was similar to that of the August 1998 LUT-1, although some degradation in situational awareness message traffic was observed and may be due to the increased network size in the FDTE/CT.

DIGITIZATION ASSESSMENT

Although much progress has been made since the Task Force XXI AWE, the current state of Digitization capabilities is immature, with a number of critical enhancements necessary to achieve an effective and suitable capability. These include improved interoperability with and across the Army Tactical Command and Control Systems, a robust network management capability to monitor the network's health and respond to identified problems, the ability to allow rapid re-establishment of the network when communication/combat losses occur or a task organization change is required, and the ability to tactically move the large and complex tactical operations centers. Testing to date has been of limited scope and relatively benign, with much larger active networks and more advanced electronic and information warfare activities needed to understand true operational performance of the Digitization system of systems. In conjunction with the robust testing needed, development of Digital TTPs is also necessary to realize the full benefits of Digitization. Current TTPs are also immature, and funding/plans to improve TTPs are not in evidence.

Based on our experience, information technology (i.e., software-intensive systems) is generally complicated, fragile in the tactical environment, and requires well-trained operators and maintainers—skills that are difficult to maintain; thus, extensive contractor support may be required. Furthermore, these phenomena continue to be observed for Digitization systems even when software development and hardware integration have matured over several cycles of the spiral development process. We believe this is due in part to the underestimation of the challenge of employing commercial hardware and software technologies in systems subjected to the rigors of the military operational environment. It is also due to the excessive optimism regarding the development and integration challenges, and results in aggressive and unachievable schedules with no slack for the solution of problems that have become the norm. Although such optimism is not unusual in the materiel developer community, there appear to be extreme pressures to maintain the goal of equipping the First Digital Division by 2000. Even when software development and hardware integration fall behind schedule, deliveries often occur on schedule, albeit with significantly reduced software functionality and poor integration. This usually results in delivery of a version of the hardware/software that does not contain the full functionality originally specified for the test event, and/or which has not been adequately tested prior to operational use. This delay impacts the New Equipment Training the test unit must undergo, and undermines the effectiveness of the unit's collective training when it finally does occur. Not surprisingly, performance goals are seldom met in this schedule driven environment.

Only when the full array of Digitization capabilities and the requisite TTPs are resident with a well-trained unit, and demonstrated in a large-scale, system-of-system event, can the Army validate their Digitization Hypothesis. Under current schedules, the first operational test of the full array of Digitization capabilities will not occur until FBCB2 IOT&E in FY02. This IOT&E is to include all

ABCS systems and functionality, and will occur in two phases: the first at Ft. Hood, and the second at Ft. Irwin, in support of the required force effectiveness evaluation. Prior to IOT&E, the intermediate ABCS objectives and integration should be demonstrated in the FBCB2 LUT-2, which has yet to be rescheduled. The Army plans to conduct a two-phased Division Capstone Exercise in FY01, and has proposed to satisfy some OT requirements during these events for a number of Digitization systems. Formal submission of these plans has yet to occur, but such an approach would be viewed favorably if software deliveries and integration, unit training, and all other entrance criteria could be met prior to the scheduled exercise. DOT&E will observe both of the Division Capstone Exercises for insights into the progress of Digitization, but successful Beyond Low Rate Initial Production Reports for systems on oversight will depend upon demonstrated operational effectiveness and suitability in approved OT events.

BLACK HAWK MODERNIZATION

Army ACAT ID Program

Number of Systems by FY24:	1,480
UH-60A:	Phased out
UH-60L:	1
UH-60M:	1,221
UH-60X:	255
Total Program Cost (60L) (TY$):	$11.5B
Average Unit Cost (60L) (TY$):	$5.0M
Full-rate production:	
UH-60A (Completed):	4QFY82
UH-60L (Complete in FY05):	2QFY88
UH-60M:	3QFY03
UH-60X (Currently unfunded):	2QFY04

Prime Contractor

Sikorsky Aircraft
General Electric

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The UH-60 BLACK HAWK is a single rotor, medium-lift helicopter that provides utility and assault lift capability in support of the full spectrum of combat and peacetime missions. The BLACK HAWK is the primary helicopter for air assault, general support, and aeromedical evacuation. Additionally, BLACK HAWKs can be configured to perform command and control, electronic warfare, and special operations missions. The versatility of this widely used aircraft provides significant ***dominant maneuver*** and ***focused logistics*** capabilities.

BACKGROUND INFORMATION

The Army began fielding the UH-60A in 1978. Over ten years, the Army procured about 1,050 UH-60A model aircraft. A 1989 power train upgrade resulted in a model designation change from UH-60A to UH-60L. Since 1989, the Army has procured 505 of the newer UH-60L models but has not modernized the previously fielded UH-60A aircraft. Procurement of 65 more UH-60L BLACK HAWKs is funded through FY05. Depot-level overhaul of up to 390 of the oldest aircraft is slated to begin in 2002.

The Army approved a new Operational Requirements Document in January 2000 that established a two-tiered approach to development and modernization. The near-term first tier aircraft, the UH-60M, will extend airframe service life while providing a Force XXI digital cockpit and improved reliability and maintainability for the BLACK HAWK fleet. The second tier requirements establish the UH-60X BLACK HAWK with increased performance and survivability capabilities. The UH-60X aircraft will include a more powerful engine and better aircraft survivability equipment. New engine technology should provide increased shaft horsepower and greater fuel efficiency. Survivability will be enhanced by the installation of the Suite of Integrated Radio Frequency Countermeasures and the Suite of Integrated Infrared Countermeasures and by improving the ballistic damage tolerance of the fuel subsystem, flight controls, and the main and tail rotor systems.

TEST & EVALUATION ACTIVITY

The Army successfully developed, integrated, and operationally tested a medical evacuation BLACK HAWK, the UH-60Q, with a digital cockpit that will be the baseline for the UH-60M. While finding that pilot situational awareness was enhanced significantly, the Army also discovered electromagnetic interference problems in the UH-60Q cockpit during operational testing. Follow-on electromagnetic environmental effects (E3) testing should soon show that subsequent integration and modifications have eliminated the problem.

Working in concert with industry, the Army has conducted flight testing of the wide chord blade (WCB) and the advanced flight control computer (AFCC). Both technologies will be installed on the UH-60M. The WCB offers increased lift, range, and speed as well as reduced procurement costs compared to the current BLACK HAWK blades. The AFCC provides the same functionality and will replace the existing obsolete flight control computer.

While not required for the UH-60M program, the Army's Aviation Applied Technology Directorate has tested improved infrared suppressors that could make the modernized BLACK HAWK less susceptible to infrared seekers. The PM has indicated that the UH-60M will have an improved IR suppressor system.

In May 2000, OSD approved the TEMP for tier one (UH-60M) testing of the BLACK HAWK modernization program. On August 31, 2000, OSD (AT&L) waived the requirement for full-up, system-level live-fire test and evaluation based on an alternate plan approved by DOT&E. This alternate plan will meet all testing and evaluation requirements in a realistic, practical, and cost-effective manner. Subsequent to that TEMP approval, the Army has modified its tier one acquisition strategy by extending EMD by two years and inserting an LRIP decision prior to the full rate production decision.

TEST & EVALUATION ASSESSMENT

It is highly probable that the Service will be able to deliver the expected system performance within the current budget and schedule. However, there are areas of concern.

The Army anticipates that replacing the UH-60A with the UH-60M will result in operations and support (O&S) savings. Intuitively, it makes sense that older aircraft would have higher O&S costs than new/rebuilt aircraft. However, a query of the Army's cost data on the UH-60A and UH-60L models has not yet confirmed this premise. Nevertheless, we anticipate that the O&S cost of the UH-60M will be comparable to the O&S costs of the UH-60L. The aircraft components, especially propulsion and airframe that comprise 85 percent of O&S costs, will be similar on the two models. The UH-60L cockpit accounts for only 10 percent of total O&S costs, so unless the UH-60M digital cockpit is dramatically less reliable, it will not be a cost driver. Since the test program will not provide enough cost data to estimate the true O&S costs of the UH-60M aircraft, conclusions about O&S cost savings for the UH-60M will likely be based on extrapolations of O&S data from the UH-60L and UH-60A.

The primary technical risk for the UH-60M is avionics. This risk will be mitigated by the Army's recent success in development and testing of the digital cockpit in the UH-60Q. From an operational perspective, it will be a challenge to explicitly demonstrate the operational benefits of the digital cockpit. The link between improved situational awareness and effectiveness is tenuous at best. Demonstration of faster and more accurate or complete digital communications, improved avionics reliability, and more accurate navigation may provide the best indications of enhanced operational effectiveness. The test program should provide ample opportunity to evaluate the digital cockpit.

The advantages of the WCB may be partially offset by an increase in vibration fatigue. Flight testing of the WCB on UH-60L aircraft has revealed vibrations at primary and secondary frequencies that have been described by the testers as noticeably different from current blades, but acceptable. We do not know what these vibrations will be like with the stiffened airframe of the UH-60M. The WCB is being used on commercial aircraft, such as the Sikorsky S-92.

Uncertainties about the specifics of how the airframes will be reinforced during remanufacture have led to questions about aircraft weight projections. At this stage in the program, the PM does not yet have proposed designs on how the airframe will be stiffened. Generally, the PM's plan is to reinforce those airframe members known to have frequent failures on fielded aircraft. But until a specific design has been accepted, weight projections will not be reliable. The projected increase in power from the WCB cannot accommodate additional weight beyond the known increase in weight due to the digital cockpit and other approved enhancements. Therefore, aircraft weight poses a risk to aircraft performance and cost.

The alternative LFT&E plan will be conducted in two sequential phases. The first phase will consist of ballistic vulnerability tests performed on individual components. The second phase will address system-level vulnerability. An operational, but not necessarily flight worthy, UH-60A or L-model ground test vehicle configured with M-model components will be used during the latter phase.

The LFT&E plan takes into account vulnerability reduction features that have been incorporated into the BLACK HAWK since its initial fielding in 1978. This plan also will use combat damage experience, subsystem qualification efforts, computer modeling and simulation, as well as sister Services' testing on similar aircraft. The LFT&E program will take advantage of ongoing Navy (SH-60R and CH-60 programs) LFT&E activities and is in the process of negotiating some cost-sharing of the required testing. The LFT&E effort is scheduled to be conducted from FY00-FY03.

BRADLEY FIGHTING VEHICLE SYSTEM-A3 (BFVS-A3)

Army ACAT IC Program

Total Number of Systems:	1,109
Total Program Cost (TY$):	$4383M
Average Unit Cost (TY$):	$3.952M
Full-rate production:	2QFY01

Prime Contractor

United Defense, Limited Partnership

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The M2A3 and M3A3 Bradley Fighting Vehicle System (BFVS) are improved versions of the M2A2 and M3A2 BFVS. The BFVS-A3 includes enhancements intended to improve lethality, mobility, survivability, and sustainability. Additionally, these enhancements are intended to provide increased situational awareness and digital command and control capabilities necessary to provide ***information superiority*** to the ***dominant maneuver*** force. The Bradley Fighting Vehicle and the Abrams Tank are the two central components of the dominant maneuver digital force.

The mission of the BFVS is to provide mobile protected transport of an infantry squad to critical points on the battlefield and to perform cavalry scout missions. The BFVS will also provide overwatching fires to support dismounted infantry and suppress or defeat enemy tanks and other fighting vehicles. BFVS-A3 enhancements include:

- Incorporation of Force XXI Battle Command, Brigade and Below (FBCB2) Integrated Combat Command and Control (IC^3) to share digital battle command information and situational awareness with all components of the combined arms team.

- The improved Bradley acquisition system and commander's independent viewer, both 2nd generation Forward Looking Infrareds (FLIR), to improve target acquisition and target engagement. A position navigation system with a Global Positioning System receiver and a backup inertial navigation system to enhance situational awareness.

- Integrated maintenance diagnostics and Built-In-Test/Built-In-Test Equipment.

BACKGROUND INFORMATION

In March 1994, the Army awarded a contract to United Defense to begin the EMD phase. Operational testing conducted prior to FY00 has included LUT I in December 1997; an Operational Experiment (OE) in September 1998; a Detection, Acquisition, Recognition, Identification (DARI) test in October 1998; and LUT II in August-September 1999.

The DARI test involved a side-by-side comparison between the BFVS-A3 equipped with 2nd generation FLIR and the baseline BFVS-A2 equipped with a 1st generation FLIR. The results of the DARI demonstrated a significantly improved capability of the BFVS-A3 over the baseline BFVS-A2 to detect, recognize, and identify targets at operationally relevant ranges. The focus of LUT II was to assess whether the BFVS-A3 possesses an increased capability over the BFVS-A2 ODS to acquire, engage, and hit targets. The results of LUT II demonstrated that the BFVS-A3 does possess an improved capability over the baseline to acquire, engage, and hit targets.

The first phase of the BFVS-A3 Live Fire Test and Evaluation, the Controlled Damage Test, was completed in FY99. This effort used non-destructive test methods to insert potential damage mechanisms, such as electrical shorts, into the system. Eighteen of 19 full-up, system-level live fire shots, across a variety of threat classes, were successfully completed in FY99.

TEST & EVALUATION ACTIVITY

No OT was conducted in FY00. The BFVS-A3 IOT&E is scheduled to be conducted in October-November 2000.

Most of the testing in FY00 has been devoted to ensuring the BFVS-A3 will be ready for IOT&E. Last year, the program modified its technical approach to integrating digital C^2. Much of the technical testing has focused on ensuring the successful integration of this new approach, called Integrated Combat Command and Control (IC^3). Software and C^2 performance testing was conducted in May-June 2000 on the BFVS-A3 with IC^3. In addition, digital communications connectivity between the BFVS-A3 and M1A2 SEP was tested at the same time. Results of this testing were positive. Required digital messages were successfully transmitted between the two platforms and the BFVS-A3's IC^3 demonstrated sufficient maturity to proceed to IOT&E.

A diagnostics demonstration was conducted during April-June 2000. The purpose of this event was to demonstrate fixes to previously identified shortfalls in both the on-board Vehicle Diagnostics and

Maintenance System as well as the off-board organizational and direct support diagnostics equipment. The results of this event were positive, demonstrating adequate diagnostics performance and sufficient technical maturity to proceed to IOT&E.

The Director approved the BFVS-A3 TEMP, Revision 5, in June 2000. This update incorporated changes resulting from the program's new technical approach to digital C^2, IC^3.

DOT&E's independent evaluation of LFT results continued in FY00. The Army conducted two exploratory shots using "new threat" Rocket Propelled Grenades (RPG) against a Bradley ballistic hull and turret in 4QFY99, along with three additional shots against range targets in March 2000. The results of these tests will be used to determine if the nineteenth, and final, full-up system LFT shot is required.

TEST & EVALUATION ASSESSMENT

The integration of IC^3 has remained the primary technical challenge to the program. IC^3 is designed to meet a key system requirement for digital battle command and is the BFVS-A3's link to FBCB2. A full evaluation of the BFVS-A3 requires that the system include functional, production-representative IC^3. As of this writing, technical testing conducted on the BFVS-A3 indicate that the system's IC^3 is sufficiently mature to enter IOT&E and successfully demonstrate system digital C^2 requirements.

As noted above, the DARI test was successful and clearly established the superiority of the BFVS-A3 2nd generation FLIR's target acquisition capability in comparison to the currently fielded system.

The full implementation of system maintenance diagnostics, both the on-board Vehicle Diagnostics and Maintenance System as well as off-board maintenance diagnostics equipment, has demonstrated sufficient technical maturity in developmental testing to enter IOT&E.

The BFVS-A3 IOT&E, to be conducted October-November 2000, will consist of 16 force-on-force battles between a BFVS-A3/M1A2 SEP equipped company team and a baseline company team consisting of BFVS-A2's and M1A2's. This event, in which 14 BFVS-A3's will participate, is intended to evaluate the overall operational effectiveness and suitability of the BFVS-A3. Results of the IOT&E are not anticipated before January 2001. The IOT&E will be conducted with only the FBCB2 component of the Army Battle Command System (ABCS). BFVS-A3 equipped units are scheduled to participate in future FBCB2 OT events, allowing for the opportunity for the BFVS-A3 to demonstrate full interoperability with the remaining components of ABCS.

Results to date from live fire testing have demonstrated a number of survivability improvements over the baseline system and have suggested possible areas for improving vehicle survivability. Test results have also demonstrated the value of Explosive Reactive Armor (ERA) and have led to further T&E activity in that area.

CH-47F IMPROVED CARGO HELICOPTER (ICH)

Army ACAT IC Program		**Prime Contractor**
Total Number of Systems:	300	Boeing
Total Program Cost (TY$):	$3.08B	
Average Unit Cost (TY$):	$9.8M	
Full-rate production:	2QFY04	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The CH-47F Improved Cargo Helicopter (ICH) is a remanufactured version of the CH-47D Chinook cargo helicopter with the new T55-GA-714A engines. The CH-47D is a twin-turbine tandem rotor helicopter designed for combat and combat support heavy-lift cargo missions. The ICH program is intended to sustain the aging CH-47D airframes and extend the aircraft's life expectancy another 20 years. Additional improvements to the ICH include: (1) fuselage stiffening (what will reduce vibrations which is expected to lead to improved reliability and reduced operating and support costs); and (2) integrated cockpit and digital architecture for Force XXI compatibility.

ICH contributes to ***dominant maneuver*** and ***focused logistics*** by transporting weapons, ammunition, equipment, troops, and other cargo in general support of combat units and operations other than war.

BACKGROUND INFORMATION

OSD approved entry into Engineering and Manufacturing Development (EMD) for the CH-47F ICH at Milestone I/II in 3QFY98 with an ACAT IC designation. Based on the perceived low risk of development, OSD delegated Milestone Decision Authority to the Army Acquisition Executive in the Acquisition Decision Memorandum dated May 19, 1998. OSD approved a TEMP update on November 6, 1998 following the award of the EMD contract and the DAB decision.

The Army awarded an EMD contract to Boeing Helicopters. Boeing subsequently awarded a subcontract to Rockwell Collins for development of the avionics package. Preliminary and Critical Design Reviews are complete. Currently, EMD activities are under way. IOT&E is scheduled for 2QFY02 and Milestone III is scheduled for 2QFY04.

DOT&E approved an alternate LFT&E plan and concurred with the Army's request for a waiver from full-up, system-level testing in December 1997. The waiver certification to Congress was provided by USD (A&T) in March 1998. A damaged CH-47D aircraft was repaired and will be used as the LFT system-level Ground Test Vehicle (GTV).

TEST & EVALUATION ACTIVITY

During pre-EMD testing, the program office, in cooperation with Boeing and the Aviation Technical Test Center, demonstrated the anticipated benefits of several ICH product enhancements on a prototype aircraft. The Vibration Reduction Test Aircraft (VRTA) was a modified CH-47D with prototype ICH airframe stiffeners, -714A engines, and modified aft pylon. Vibration flight testing of the VRTA demonstrated that it is possible to lower the CH-47's three-per-revolution lateral first harmonic by approximately 60 percent in the cockpit area. Stiffening also lowered the vertical second harmonic of six-per-revolution in the cockpit by about 50 percent. The -714A engines have been flight tested in the VRTA and qualified for use in the ICH. In a demonstration orchestrated by the program office, soldiers from the 160th Special Operations Aviation Regiment removed and reinstalled the modified aft pylon of the VRTA. In this transportability demonstration, the modifications to the aft pylon significantly reduced the time (from 5:30 hours to 2:05 hours) and effort (from 44 man-hours to 19 man-hours) to prepare the ICH for air transport compared to the CH-47D.

The Live Fire Test program started in 2QFY99. The program has prepared three event design plans for testing and for modeling and simulation, and four detail test plans that describe the testing for the Cockpit Skin Panels, Cockpit Components, Fuel Sub-system and Propulsion/Engine Sub-systems. Fire Detection/Suppression System and Tunnel Hydraulics Test Plans are in preparation for tests scheduled to begin in FY01.

The program initiated ballistic testing of the Cockpit Skin Panels in 3QFY99 and completed 164 of 195 shots. Testing of the T55 engine and fuel sub-system started in 2QFY00. Cockpit component testing is scheduled to begin during 3QFY01.

Testing of the T55 engine and the fuel sub-system included both controlled damage dynamic simulations on the CH-47D GTV and ballistic tests on actual components. More than 40 controlled damage tests on the T55 engines of the GTV have been completed to date. The fuel sub-system tests performed to date include 12 controlled damage tests on the GTV, 24 ballistic tests on four actual components installed in a surrogate CH-47A fuselage section simulating operational fuel flow conditions in the components, and 3 tests of these components in the GTV with engines and rotors running.

In addition, as part of the DOT&E Joint Live Fire program, eight static tests were conducted for the CH-47D rotor blades, which are the same as those of the F-model. Therefore, these data are directly applicable to the LFT&E of the CH-47F. Quasi-static testing of the blades is scheduled to start in FY01.

TEST & EVALUATION ASSESSMENT

It is highly probable that the service will be able to deliver the expected system performance within the current budget and schedule. If the program proceeds as planned, the proposed integrated test program should provide sufficient data to support a preliminary assessment of the operational effectiveness and suitability of the CH-47F with 130 hours of developmental and 90 operational test flight hours. However, there are some areas of concern.

From a technical perspective, the two primary development areas are low risk. Avionics upgrades will rely largely on non-developmental components and systems designed, manufactured, and integrated by Rockwell Collins. Their avionics package has already been fielded on the MH-47D and MH-60L helicopters and operated by the Army's 160th Special Operations Aviation Regiment. Likewise, airframe stiffening of the VRTA aircraft has already demonstrated sufficient reductions in vibration levels. The remaining challenge will be to integrate these solutions into the production aircraft without inducing unanticipated software failures or unintended weight growth.

From an operational perspective, it will be a challenge for the Army to demonstrate the operational benefits of the digital cockpit. In operational testing of the UH-60Q, the digital cockpit provided a significant improvement in the pilot's awareness of his position with respect to the route and final objective. In operational testing of the MH-60K also with a digital cockpit, navigation accuracy exceeded 98 percent. To date, the Army's System Evaluation Plan does not describe how the benefits of navigation enhancements, moving map displays, interfaces with the Tactical Internet, tactical situational awareness, and integration with other digital battlefield systems will be operationally demonstrated.

From a suitability perspective, the evaluator anticipates that the aircraft will achieve reliability and maintainability (R&M) estimates with 70 percent confidence by the end of IOT&E. Following IOT&E, the program anticipates approximately 1,000 flight hours of R&M data will be collected during the training and fielding of the first unit equipped to complete the evaluation. The follow-on R&M data collection will not be completed in time to support the MS III decision but is critical to demonstrating the anticipated reliability and maintainability improvements.

Even with follow-on R&M data, we will not have enough information to accurately estimate long-term Operations and Support (O&S) costs for this aircraft. To the extent that R&M drives O&S costs, we will have initial indications. Other O&S cost drivers such as the quality of maintenance performed in fielded units, costs of spares, and Army O&S funding levels will not be understood until much later after fielding. It is unlikely the test program will confirm or refute the anticipated O&S savings.

Lastly, the CH-47F LFT&E is a fairly robust program. Ample test data from the Army's LFT of the CH-47F and the DOT&E JLF program of the basic CH-47D are expected to provide a good evaluation of the CH-47F. The only LFT&E concern at this time is that the dynamic testing of the main rotor blades (under the JLF program) may not occur prior to the Milestone III decision due to the fact that the same helicopter will be used to support earlier LFT of other components unique to the CH-47F. In addition, the GTV may not be viable at the completion of the LFT.

CHEMICAL DEMILITARIZATION (CHEM DEMIL)

Army ACAT IC Program

Total Number of Stockpile Disposal Systems:	9
Total Program Cost (TY$) for Stockpile Disposal:	$11.8B
Total Number of Non-Stockpile Disposal Systems (6 types):	15 total
- EDS-1, EDS-2	3, 4
- MAPS	1
- MMAS	3
- MMD-1	1
- PBAFF	1
- RRS	2
Total Program Cost (TY$) for Non-Stockpile Disposal:	$1.32B

Prime Contractors:

Johnston Atoll - Washington Group
Tooele, UT - EG&G
Anniston, AL - Westinghouse Anniston
Umatilla, OR - Washington Group
Non-Stockpile: Teledyne Brown
Pine Bluff, AR - Washington Group
Aberdeen, MD - Bechtel
Newport, IN - Parsons
Pueblo, CO - TBD
Blue Grass, KY - TBD

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Chemical Demilitarization (Chem Demil) program is responsible for the destruction of 100 percent of the U.S. stockpile of lethal chemical agents and munitions by April 29, 2007. The Chem Demil program is managed by the U.S. Army and consists of three separate projects:

- Chemical Stockpile Disposal Project
- Alternative Technology and Approaches Project
- Non-Stockpile Chemical Materiel Project

The *Chemical Stockpile Disposal Project* is responsible for destruction of the U.S. stockpile of unitary chemical weapons. A chemical weapon destruction facility has been or will be constructed at each of the nine stockpile storage sites. The first five facilities use incineration technology.

Incineration disposal facilities:

1. Johnston Atoll Chemical Agent Disposal System: operational
2. Tooele Chemical Agent Disposal Facility (UT): operational
3. Anniston Chemical Agent Disposal Facility (AL): under construction
4. Umatilla Chemical Agent Disposal Facility (OR): under construction
5. Pine Bluff Chemical Agent Disposal Facility (AR): under construction

Neutralization disposal facilities:

6. Aberdeen Chemical Agent Disposal Facility (MD): under construction
7. Newport Chemical Agent Disposal Facility (IN): in design

Alternative disposal technologies still to be determined:

8. Pueblo Chemical Agent Disposal Facility (CO)
9. Blue Grass Chemical Agent Disposal Facility (KY)

Ninety percent of the unitary chemical stockpile is now under contract for destruction.

The ***Alternative Technology and Approaches Project*** is responsible for conducting pilot testing of alternative destruction technologies. By law, the U.S. Army and the National Research Council (NRC) completed a detailed examination of alternatives to the baseline chemical weapons disassembly and incineration process. The NRC recommended that the Army continue the current baseline incineration program at the sites that were operational or under construction while evaluating potential alternative technologies for bulk chemical agent destruction. The Army elected to use chemical neutralization of agent followed by post-treatment of the neutralized products at the Aberdeen and Newport facilities.

At the direction of Congress, the Army established the ***Assembled Chemical Weapons Assessment (ACWA) Program*** in 1996. This program is separate from Chem Demil, and was designed to evaluate alternative technologies for the Pueblo and Blue Grass disposal facilities. The *ACWA Program* provided a supplemental report to Congress on October 1, 1999, which contained the demonstration results of alternative technologies. The final destruction method for the Pueblo and Blue Grass facilities is still under consideration. The Army is working Environmental Impact Statements for these sites.

The ***Non-Stockpile Chemical Materiel Project*** is responsible for the destruction of non-stockpile chemical warfare materiel, including the components of binary chemical weapons, miscellaneous chemical warfare materiel, recovered chemical weapons, former production facilities, and buried chemical warfare materiel. The following distinct hardware systems are under development, each requiring its own developmental and operational testing:

- The Explosive Destruction System (EDS-1 and EDS-2): A mobile capability designed to explosively open chemical agents; contain their blasts, fragments, and contents; and destroy the chemical agent contents in a safe and environmentally compliant manner. EDS-2 will be able to destroy larger scale munitions.

- The Mobile Munitions Assessment System (MMAS): Designed to store and transport U.S. Army Technical Escort Unit equipment and personnel to a recovered munitions site where they will be able to identify the condition and contents of recovered munitions and other containers suspected of containing chemical warfare agents. MMAS assesses the suspect munition on-site without opening and with minimal disturbance to the recovered munition.

- The Munitions Assessment and Processing System (MAPS) (one of two fixed facility replacements for the Munitions Management Device Version 2): A controlled system to allow for separation of chemical payload from an explosively/non-explosively configured munition; decontaminate munition bodies; and destroy the explosively configured bodies. MAPS will be a fixed facility at Aberdeen Proving Ground only.

- The Munitions Management Device Version 1: A transportable system designed to destroy recovered non-explosively configured chemical warfare materiel, up to the size of a 500-pound chemical weapon.

- The Pine Bluff Arsenal Fixed Facility (one of two fixed facility replacements for the Munitions Management Device Version 2): Will be developed to destroy recovered explosively/non-explosively configured chemical warfare materiel as well as bulk items. This facility will be independent of the Pine Bluff Chemical Agent Disposal Facility.

- The Rapid Response System: A transportable system designed to destroy Chemical Agent Identification Sets (CAIS). CAIS are glass tubes that contain small amounts of diluted chemical agent or industrial chemicals that simulate chemical agents. CAIS were developed to train military forces on the proper procedures for identifying chemical agents.

The Chemical Demilitarization Program supports the ***Joint Vision 2020*** concept of ***full dimensional protection*** by placing the United States in compliance with the Chemical Weapons Convention (CWC). The protections afforded by compliance with the CWC are twofold: the elimination of the United States' chemical weapons stockpile and related chemical warfare materiel removes a significant peacetime safety hazard while the CWC's binding international treaty protections and penalties reduce the threat of chemical weapons use against the United States' military and people.

BACKGROUND INFORMATION

The Chem Demil program was placed under OSD oversight as an Acquisition Category (ACAT) ID Major Defense Acquisition Program in December 1994. The Chem Demil program designation was changed to ACAT IC in March 1998.

At the time that the Chem Demil program came under OSD oversight, the first disposal facility at Johnston Atoll had already completed testing and was operational (May 1993), and systemization testing at the second disposal facility at Tooele, UT was ongoing. Systemization testing is an end-to-end test that uses surrogate chemicals in place of actual chemical agents. Since systemization testing had started before the program came under OSD oversight, it was conducted without an OSD-approved Test and Evaluation Master Plan, and DOT&E did not perform an independent evaluation. However, DOT&E reviewed the evaluation monitored by the U.S. Army Materiel Systems Analysis Activity and concurred with its conclusion that there were no issues to preclude the start of operations. The Tooele Chemical

Agent Disposal Facility was declared operational and began operations with chemical agents in August 1996. As of September 24, 2000, the Johnston Atoll and Tooele facilities had successfully destroyed approximately 21 percent of the total U.S. chemical weapons stockpile (originally 31,496 agent tons).

A separate TEMP is required for each of the remaining seven *Chemical Stockpile Disposal Project* sites. OSD approved the TEMP for the Anniston facility on July 15, 1999.

The *Chemical Demilitarization Program* is beyond Milestone III, and a Beyond Low Rate Initial Production report is not required.

TEST & EVALUATION ACTIVITY

The ***Chemical Stockpile Disposal Project*:** Systemization testing (i.e., end-to-end testing with surrogate chemical agent) will begin at the Umatilla, Anniston, and Pine Bluff facilities as construction at each site is completed. Component level developmental testing is already in progress at these sites. The Umatilla and Anniston facilities are scheduled to begin chemical disposal operations in December 2001 and January 2002, respectively. Pine Bluff operations are scheduled to begin in August 2003. DOT&E is an active member of the Systemization Integrated Process Team, which reviews test planning activities for these facilities. The Army developed TEMPs for the Umatilla, Aberdeen, and Newport sites, which are currently in coordination within the Department of the Army before submission to OSD for formal approval. OSD approved the Aberdeen TEMP in November 2000. When the Umatilla TEMP is approved, the Army plans to begin developing the Pine Bluff TEMP.

The ***Non-Stockpile Chemical Materiel Project****:* In June 2000, DOT&E approved the Army's Overarching Test Concept Plan for the Non-Stockpile Chemical Materiel Project. The Overarching Test Concept Plan was developed in lieu of a TEMP based on agreement between representatives from OSD and the U.S. Army.

- The Explosive Destruction System (EDS): An extended series of initial developmental tests using a prototype EDS-1 system were conducted at Porton Down, United Kingdom (UK), from May-July 2000. This developmental testing was conducted using phosgene and mustard agent munitions supplied by the UK. Several hardware and process deficiencies were identified during this testing, which was not unusual for an early developmental prototype. This testing has shown the value of employing actual agent materiel early in the testing process. A second phase of engineering development testing is currently being conducted in the UK after which the Army plans to relocate the EDS-1 prototype to Aberdeen Proving Ground to conduct a pre-operational survey with simulant followed by operational testing with phosgene and mustard agent. EDS-2, which can handle larger-scale munitions, is still under development.

- The Mobile Munitions Assessment System (MMAS): MMAS operational testing was conducted over a two-week period from November 16, 1999-December 3, 1999 at Aberdeen Proving Ground. The U.S. Army Materiel Systems Analysis Activity (AMSAA) published an Independent Evaluation Report in June 2000, recommending that MMAS be released for operational use by the U.S. Army Technical Escort Unit. There were no major discrepancies identified during the testing, but there were numerous suggestions for improvement. DOT&E observed portions of the operational testing and concurs with the report's recommendations. The Program Manager subsequently approved MMAS for operational use.

- The Munitions Management Device Version 1 (MMD-1): Developmental testing using live phosgene agent at Dugway Proving Ground began on June 27, 2000. During testing of the first four phosgene rounds, testing had to be stopped several times due to a minor leak and several hardware failures and processing problems that necessitated maintenance actions and in one case a configuration change. The Project Manager truncated further MMD-1 phosgene testing pending reassessment of the MMD-1 system. A pre-operational survey with mustard simulant, followed by a developmental test using live mustard agent, is planned to begin in December 2000. Test results will be used to help develop the Pine Bluff Arsenal Fixed Facility for disposal of various chemical agents at that location.

- The Rapid Response System: On September 22, 2000, the state of Utah approved the permits to begin chemical operations developmental and operational testing with live Chemical Agent Identification Sets at the Deseret Chemical Depot in Utah.

- The Munitions Assessment and Processing System and the Pine Bluff Arsenal Fixed Facility are still in early development. No operational test activities have been conducted to date.

TEST & EVALUATION ASSESSMENT

U.S. Army testing of stockpile and non-stockpile systems in the *Chemical Demilitarization Program* has been adequate to ensure the safe and efficient disposal of the inventory of chemical warfare materiel. The *Chemical Stockpile Disposal Project* management staff has developed thorough TEMPs for the stockpile incineration disposal facility at Umatilla and the stockpile neutralization facilities at Aberdeen and Newport. As previously noted, these TEMPs are currently in coordination within the Department of the Army before delivery to OSD for approval, with the exception of the Aberdeen TEMP, which has already been approved.

The U.S. Army has made considerable progress in resolving previously identified shortfalls in several *Non-Stockpile Chemical Materiel Project* systems, including the Rapid Response System, the Munitions Management Device Version 1, and the Mobile Munitions Assessment System. Analysis of the test results of the pre-operational surveys and operational testing revealed significant progress in resolving operating procedures and training shortfalls identified earlier in these systems. The U.S. Army Materiel Systems Analysis Activity is thoroughly evaluating the non-stockpile systems prior to beginning operational testing with live chemical agent and is providing independent recommendations to the *Non-Stockpile Chemical Materiel Project* office.

Since originally assessing the validity of the Operational Verification Test at the Johnston Atoll facility and systemization testing at the Tooele facility, DOT&E has continued to monitor operations at these facilities. On May 8, 2000, an agent emission that exceeded State of Utah permit levels occurred at the Tooele Facility, resulting in suspension of activities. Four independent investigations were conducted by the U.S. Army, the Utah Department of Environmental Quality, the on-site operations contractor (EG&G), and the Center for Disease Control and Prevention. Corrective actions were identified and implemented, and the Tooele facility restarted chemical agent disposal operations on September 20, 2000. The system designs for the disposal facilities under construction at Umatilla, Anniston, and Pine Bluff are incorporating lessons learned from the Johnston Atoll and Tooele facilities.

As previously noted, initial developmental testing of the non-stockpile Explosive Destruction System demonstrated the value of testing with live chemical agent early in the development process. In the case of EDS, one incident included degradation of the seals by corrosive action of the agent and condensation of agent in unexpected places, leading to leaks when the chamber was opened. Pre-operational surveys with simulant could not have demonstrated this same chemical reaction. Obviously, the earlier these problems are detected, the earlier they can be corrected to ensure safe and efficient operations. Tests with live chemical agent are scheduled in the formal operational tests, consistent with each state's permitting processes.

CLOSE COMBAT TACTICAL TRAINER (CCTT)

Army ACAT II Program		**Prime Contractor**
Total Number of Systems:	9 fixed sites 12 mobile platoon sets	Lockheed Martin
Total Program Cost (TY$):	$850M	
Full-rate production:	4QFY99	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Close Combat Tactical Trainer (CCTT) is a combined arms tactical training simulator designed to assist armored and mechanized infantry units in training for combat. The use of the Abrams Tank and the Bradley Fighting Vehicle simulators to train soldiers in maneuver and in command and control, while operating in a combined arms environment, is a central component of the ***dominant maneuver*** force.

The CCTT system consists of a group of fully interactive, networked simulators and command, control, and communications workstations. The system will replicate—via individual manned simulators—the Abrams tanks, Bradley Fighting Vehicles, as well as other vehicles and weapon systems found in or supporting an armored or mechanized infantry company team. CCTT is designed to train from crew level through company/team level. Additionally, CCTT supports the training of selected battalion level tasks. CCTT simulates, in real-time, the conduct of combat operations under varying conditions of visibility and weather. An appropriate and challenging opposing force requires realistic individual, crew, and unit actions. This simulation will permit soldiers to train with reduced real-world restrictions caused by weapon effects, safety, and terrain limitations.

CCTT exists in both fixed-site and mobile versions. The fixed-site version is capable of running five simultaneous platoon-level exercises. The mobile version is road transportable within the United States to provide reserve forces platoon-level training.

BACKGROUND INFORMATION

In May 1992, the Army authorized CCTT to proceed into the EMD phase of acquisition. CCTT IOT&E was conducted from December 1997-June 1998. During this test, baseline performance data were collected at the National Training Center (NTC) from three battalion task forces that did not use CCTT in their training prior to deploying to NTC. Subsequently, a unit that used CCTT in its training prior to deploying to NTC completed a similar series of training exercises. The criteria used to determine CCTT effectiveness were whether units trained with CCTT performed at least as well as units trained without CCTT. At the National Training Center, the performance of CCTT-trained companies exceeded the performance of the baseline companies. The CCTT-trained platoons performed at least as well as the baseline platoons.

During IOT&E, CCTT suitability data were collected over an 11-week period at the Ft. Hood fixed site using company-sized units. While the system met many of its suitability requirements; e.g., completing 90 percent of its training exercises without a system abort, none of the manned modules met the reliability requirements. Overall, the system demonstrated a 42 percent probability (versus a 90 percent requirement) that no more than 10 percent of each type of manned module would be down for more than 30 minutes during a normal training day. Additionally, as a result of system function failures, CCTT experienced frequent short duration interrupts that were excessively disruptive of unit training.

Based upon system performance during IOT&E, the Director assessed CCTT as operationally effective, but *not operationally suitable* in his November 1998 B-LRIP.

In November 1998, the AAE authorized full-rate production for CCTT, while directing that CCTT demonstrate operational suitability prior to fielding.

FOT&E 1A was conducted in March 1999 at Ft. Knox, KY. This event was designed to assess CCTT's new image generator as well as its progress towards reducing so-called vehicle flips through improvements in the vehicle dynamics model. Image generator lock-ups were the most frequent hardware failure noted during IOT&E while vehicle flips were the most frequent software failure. During FOT&E 1A, image generator performance was considerably improved over its IOT&E performance, with a demonstrated 73 percent reduction in image generator failures. Vehicle flips were also substantially reduced during FOT&E 1A. While the results of FOT&E 1A indicated that the program was making progress towards achieving operational suitability, this test was not designed to establish overall system suitability.

TEST & EVALUATION ACTIVITY

FOT&E 1B was conducted at Ft. Benning, GA, during July-August 2000 to re-examine suitability issues not met during IOT&E. During this four-week test, two armor and two mechanized infantry companies conducted platoon, company/team and battalion-level exercises designed to meet their specific training objectives. More battalion-level exercises were conducted during this test than during IOT&E, placing greater stress on the CCTT system. Based on a revised operational concept developed and approved by the Army, one of the suitability criteria was revised for the FOT&E 1B. The old criterion, which read: *the system will demonstrate a 90 percent probability that no more than 10 percent of each type of manned module at a given site are simultaneously down for more than 30 minutes during a normal training day,* was revised to read, *the system will demonstrate no less than 90 percent availability for each major subsystem during the normal training day.* This revision reflects the standard definition of operational availability.

TEST & EVALUATION ASSESSMENT

Based upon its performance during FOT&E 1B, DOT&E now assesses the CCTT system as *operationally suitable*. During FOT&E, the system demonstrated an operational availability for each major sub-system of 98 percent, versus the revised criterion of 90 percent. (CCTT would have met the original criterion as well). The system also met the criterion of completing 90 percent of its training exercises without a system abort by successfully completing 95 percent of the scheduled training exercises. Additionally, the frequency of short duration interrupts, which significantly disrupted training during IOT&E, was reduced by over 50 percent for company level exercises, from 6.5 interrupts per training session in the IOT&E to 2.3 interrupts during FOT&E. A similar 50 percent reduction was noted for platoon exercises, dropping from an average of 1.4 interrupts per platoon exercise during IOT&E to 0.6 interrupts during FOT&E. Significantly, based on user responses after FOT&E, the training unit did not view the short duration interrupts as having a negative impact on training, whereas during IOT&E user responses indicated that the level of short term interrupts were unacceptable.

The improvements demonstrated during FOT&E 1B are a direct result of improved overall system reliability. Mean Time Between Essential Function Failures (MTBEFF) increased significantly for the Abrams Tank and Bradley Fighting Vehicle manned modules. The Abrams module MTBEFF improved from approximately 30 hours to 100 hours while the Bradley module MTBEFF improved from 35 hours to 83 hours. The improvement in the failure rate for the image generators evident during FOT&E 1A at Ft. Knox continued during FOT&E 1B. Terrain data base software failures, which cause vehicles to flip at certain locations, continued at a rate comparable to that experienced during IOT&E. However, the low frequency of these interrupts did not significantly affect training.

Although DOT&E now considers the CCTT system to be operationally effective and suitable, the CCTT program must continue efforts to ensure CCTT's future effectiveness as a tactical trainer. CCTT must be updated as changes are made to currently fielded systems as well as when new combat systems are introduced. Upgraded combat vehicles, such as the BFVS-A3 and M1A2 SEP tank, as well as new platforms and weapons systems, must be incorporated into the system. ATTCS digital command and control capabilities will also need to be effectively integrated into CCTT. Maintaining weapons system currency will be critical to ensuring the continued viability of CCTT as a training tool.

The CCTT program also plans to implement a series of Pre-planned Product Improvements (P^3I) in the coming years. P^3I initiatives include improved after action review capabilities, new terrain data bases, and improved semi-automated forces. These P^3I efforts should be sustained. Additionally, adequate T&E resources should be allocated by the Army to ensure all system upgrades are adequately tested.

COMANCHE (RAH-66)

Army ACAT ID Program

Total Number of Systems:	1,213
Total Program Cost (TY$):	$47.8B
Average Unit Cost (TY$):	$30.3M
Full-rate production:	1QFY07

Prime Contractor

Boeing/Sikorsky

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The RAH-66 Comanche is a twin-engine, two-pilot light attack/armed reconnaissance helicopter being developed for the U.S. Army by a joint venture comprising Boeing Defense and Space Group, Helicopters Division, and Sikorsky Aircraft Division of the United Technologies Corporation. The Comanche features a five-bladed bearingless main rotor, a shrouded tail rotor, a low Radar Cross-Section (RCS) composite fuselage with retractable weapons pylons, a fly-by-wire flight control system, and a fully integrated cockpit. The Mission Equipment Package (MEP) incorporates a radar and forward-looking infrared and image-intensified television sensors for night flying and target acquisition. The Comanche will initially be armed with the Hellfire missile, the air-to-air Stinger missile, 2.75-inch aerial rockets, and a turreted 20mm gun.

The Comanche is intended to replace OH-58 helicopters in attack and most cavalry units and the AH-64 Apache in the reconnaissance role in the heavy attack units. The Comanche is a highly survivable, ***dominant maneuver*** platform that leverages ***information superiority*** *and* ***precision engagement*** to provide an element of ***full-dimensional protection*** to the ground maneuver force.

BACKGROUND INFORMATION

The development of the Comanche helicopter began in 1983 when it was first called the Light Helicopter Experimental (LHX). In the early 1980s, the LHX was envisioned to be a family of low-cost, lightweight helicopters that could come in a scout, utility, or attack version. Originally, all versions were to be single-seat aircraft, but by 1988, the Army chose a two-seat concept, decided on a single version (combined armed reconnaissance and attack), and reduced the planned acquisition from 4,292 to 2,096. Force structure changes and increased costs subsequently decreased the acquisition quantity to 1,213.

The Milestone (MS) I ADM (1988) and TEMP envisioned an operational evaluation of an integrated system before MS II. However, the program has been subsequently restructured several times, primarily as a result of funding reductions. The most severe reduction in funding occurred in the 1994-1995 timeframe. As a result, the program schedule was extended significantly. Although some funding has been returned, the program has never fully recovered from the turbulent funding stream. Many developmental activities were delayed and over the course of time compressed up against MS III. Many of the program issues experienced today are predictable results of the 1995 "survival mode" restructure. Consequently, testing up to now has been largely restricted to individual sub-systems or surrogates of those sub-systems.

First flight of one of the two prototype aircraft constructed during PDRR occurred in January 1996. A fully integrated aircraft is not currently scheduled to be available until FY05. An updated TEMP was approved by OSD in February 2000. The program entered the EMD stage following a DAB-level MS II decision in April 2000; MS III and Initial Operational Capability are scheduled for December 2006.

The Comanche program was designated an LFT&E system in November 1989. The LFT&E strategy was approved in fall 1995, and was recently revised as part of the updated TEMP in February 2000.

TEST & EVALUATION ACTIVITY

Test and evaluation activities, which focused on supporting the program's MS II DAB review, consisted of a TEMP update and a series of technical demonstrations, largely at sub-component level, conducted at the end of 1999 and in early 2000 primarily to show that MS II exit criteria were met. (The MS II exit criterion categories were Vertical Rate of Climb (VROC), Forward Looking Infrared Recognition Range, Radar Cross Section, Infrared Signature, Ballistic Vulnerability, Supportability, and Comanche Radar (CR) performance.) The associated tests, designed and conducted by the system contractor and witnessed by the government, were expected to prove a degree of sub-system maturity prior to the MS II decision.

Although not a test and evaluation activity *per se*, system evaluators observed a 3-week Force Development Experiment that used a simulator called the Comanche Portable Cockpit to develop and refine crew tactics, techniques, and procedures for the aircraft.

TEST & EVALUATION ASSESSMENT

Considering the history of the program as described in the Background Section of this review and the MS II Exit Criteria test data, it is highly unlikely that the Service can deliver the expected system performance within the current budget and schedule. Lacking an operational assessment of an integrated system, it is difficult to predict with any degree of confidence whether the individual subsystems can be successfully integrated, whether the subsystems will function properly in an operational environment, or whether, in concert, they will provide the anticipated benefits in operational performance.

For this assessment, the MS II exit criteria data were analyzed in terms of their contributions to the objectives of the developmental program and to address other areas of technical risk that could significantly affect achieving the program objectives. The results of the MS II exit criteria testing were encouraging, but areas of concern remain. One of the MS II exit criteria for the CR was not demonstrated, and the CR's performance against stationary targets is a particular concern. Other important issues include the potential impact of: (1) aircraft weight growth on flight performance, (2) vibration and lack of directional stability and the effect of these on flight performance and target acquisition, (3) aircraft reliability, and (4) the ability to integrate the many MEP components effectively.

Comanche Radar Performance. During the program restructure in 1998, the Service moved the development of the CR forward in time five years and added MS II exit criterion for radar development. The CR MS II exit criterion was for Comanche to achieve the specified probability of detection (P_d) and probability of correct classification (P_{cc}) of at least 80 percent of the moving target performance range specified for "typical threat vehicles." An expedient test article was assembled, consisting of the one-of-a-kind developmental electronically steered antenna (ESA) and an early model Longbow radar. This system was a development testbed, not a production prototype of the objective system, and it is expected that few components of the test article (hardware or software) will be common to the objective system. To reduce cost and disruption to system development activities, the test was performed with the radar mounted on a tower located near Baltimore-Washington International Airport. The use of these expedient facilities allowed only helicopters as moving targets and, for reasons of availability, a UH-1 helicopter was used as a surrogate for all air and ground moving targets. In this test, the CR failed to meet the P_d exit criterion, achieving 49 percent (vice 80 percent) of the required range because of excess losses in the ESA and lower target RCS than predicted. During subsequent testing at Yuma Proving Grounds using tank targets, the CR did demonstrate performance that exceeded the MS II exit criterion for P_d. Because only one target type was available for each test, the P_{cc} estimates that were produced were not meaningful and could not be compared to the P_{cc} exit criterion.

Although the contractor is on a path to identify ESA problems and improve moving target detection performance, stationary target detection performance is a significant, and yet untested, program issue. A validating data collection campaign has been planned for 2002.

Weight Growth Impact on Flight Performance. There is a concern that weight increases will prevent the aircraft from meeting its VROC requirement. Provided the production aircraft does not exceed the predicted empty weight of 9,300 pounds by more than (approximately) 115 pounds, it should achieve the MS III VROC requirement (500 feet per minute), if weight growth exceeds that which is now forecasted then it will not. DOT&E's assessment of the Comanche's weight projections found several questionable areas, including overly optimistic expected weight reductions and questionable estimates of future weight growth. Overall, DOT&E concluded that, although the contractor may achieve 80 percent of their projected weight savings, the helicopter's weight will grow more than anticipated, and thus the final weight may be approximately 9,500 pounds. If this occurs, DOT&E estimates that the aircraft's

VROC under the stated conditions will be approximately 430 feet per minute, rather than the required 500 feet per minute.

Vibration and Directional Stability. Flight-testing associated with envelope expansion has gone well. The prototype aircraft's demonstrated flight envelope significantly exceeds that of the OH-58D, which should result in improved operational capability. As an example, increases in forward, rearward, and lateral airspeeds would allow the Comanche to take off and hover at higher crosswind speeds than the OH-58D, with attendant improvements in maneuverability and controllability.

However, challenges remain. Flight-testing revealed a noticeable tail buffet as the aircraft's speed reached 80 to 100 knots. Although this does not immediately and directly affect flight safety, it is clearly undesirable from the user's perspective (vibration levels may interfere with weapon targeting, and buffet loads can contribute to tail structural fatigue). A reshaped pylon, first flight tested in 1999, reduced tail buffeting but compromised directional stability. Additional corrective changes have been identified and evaluated in wind tunnel testing, but have not been flight-tested. Furthermore, these corrective actions may have unintended consequences such as increased aircraft weight or increased RCS. Also, later aircraft will be equipped with larger rotors (an increase of one foot in diameter) and blades fitted with anhedral tips. At this point, it is difficult to predict what effects the CR, larger rotor, and blade tip changes will have on the tail buffeting/directional stability problems.

MEP Integration. Overall, the Comanche has a risky test and evaluation strategy for integrating the MEP components on the aircraft. Most testing involving the integration of the complete MEP on the aircraft will not occur until the end of the EMD phase. The resulting schedule compression allows little reserve in the timetable, thereby increasing the impact of unforeseen events/delays.

Comanche Reliability. Given the importance of reliability to the eventual assessment of the Comanche's operational suitability, this issue received considerable scrutiny at the MS II review. Although the program office/contractor has put into place a comprehensive system to identify and correct failure modes, corrective actions for identified failure modes generally will not be implemented except at several discrete points in time, because of the compressed developmental schedule. Because of this lag in applying fixes, it will be difficult to demonstrate improvements in aircraft's reliability by means of testing. Consequently, there will be little evidence that Comanche will meet its reliability requirements before the MS III decision.

Ballistic Vulnerability. The LFT&E MS II Exit Criteria Ballistic Vulnerability tests demonstrated structural damage tolerance potential for five critical components via ballistic impact, followed by structural fatigue testing and/or analysis. The MS II exit criterion called for damage tolerance potential, to be demonstrated via ballistic testing against the primary threat and engineering analysis for the main rotor flexbeam, fuel tank panel, composite panels, main rotor mast, and fantail drive shaft. The goal was to demonstrate component ability to maintain safe operation, following ballistic impact, for a minimum of 30 minutes. The plan was to conduct ballistic testing against the primary API threat under static loading, and to perform post-impact fatigue and residual strength tests. The initial ballistic damage characterization and subsequent damage growth was to be determined both visually and using ultrasonic, non-destructive inspection (NDI) techniques.

The main rotor flexbeam and the fantail drive shaft components were tested under simulated flight loads during ballistic impact, evaluated for post-impact fatigue and residual strength, and subjected to NDI of the damaged articles. The fuel tank panel test consisted of a ballistic impact into the fuel tank of the full-scale static test article filled (two-thirds level) with water to determine the hydrodynamic ram effects on the fuel tank structure and surrounding support structure. A visual inspection was made subsequent to the ballistic impact. The remaining two components (main rotor mast and composite panels) were supported in a realistic representation of the actual vehicle configuration, but were not loaded at the time of impact. Structural damage during the ballistic tests was monitored visually. These components did not include a post-test structural investigation. The composite panels included ultrasonic NDI. The post-impact investigation of these two components consisted of a review of the damaged specimen and a correlation of this damage against the contractor's predictive methodology to determine residual strength.

More recently, the contractors initiated an additional series of Risk Reduction ballistic and structural tests on evolving design configurations for several major components (i.e., main rotor blade and mast, tailcone and shroud, composite panels and Fantail) against larger caliber threats. The purpose for the redesign of these components is to reduce weight and cost.

The remainder of the LFT&E program includes component qualification and subsystem level ballistic testing for 27 critical components, as well as full-up system level dynamic testing on a pre-production-configuration aircraft. However, because of the compressed nature of the EMD phase, it will be extremely difficult to correct any weaknesses discovered during the LFT&E, and there is a schedule risk to accomplish the stated goals of the ORD.

Risk Mitigation. To help manage these risks, OSD directed that there would be two OIPT-level Interim Decision Reviews for the Comanche program: the first in January 2003 and a second in January 2005. These reviews will focus on MS II concerns (weight growth, flight performance, CR performance, reliability, and MEP integration), test results, and schedule execution.

COMMAND AND CONTROL VEHICLE (C2V)

Army ACAT III Program

Total Number of Systems:	102
Total Program Cost (TY$):	$499M
Average Unit Cost (TY$):	$4.9M
Full-rate production:	1QFY00

Prime Contractor

Unified Defense, LP; Rosslyn, VA

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Command and Control Vehicle (C2V) was under development to provide a highly mobile, survivable, and reconfigurable platform capable of hosting current and future command, control, communications, computer, and intelligence (C^4I) systems for operational planning. C2V was expected to be used by battalion through corps battle staffs in heavy force operations in support of the ***Joint Vision 2020*** concept of ***information superiority*** for battalion through corps leaders, with a resulting improvement in the employment of a ***dominant maneuver*** force. However, the **C2V program was cancelled in late 1999** as one of the programs identified as bill payers for the Army's transformation to more deployable forces.

BACKGROUND INFORMATION

The C2V program was under DOT&E oversight for both OT&E and LFT&E. The C2V TEMP was approved in October 1993, and updated in March 1994 following a December 1993 Milestone II. The LFT&E strategy was approved in July 1996, but contained an open issue regarding the applicability of the Explosively Formed Penetrator (EFP) as a threat munition to the system. The issue was resolved in FY98, and an EFP shot was included in the full-up, system-level Live Fire Test conducted during FY99-00.

In early FY99, the Program Manager decided to modify the armor composition of the mission module used in the prototypes and LRIP I vehicles. For LRIP II and beyond, the sidewalls of the module were to be made from monolithic aluminum armor rather than the aluminum/Kevlar combination initially used. The Program Manager provided an LRIP II system for the full-up, system-level Live Fire Test. C2V participated as an initiative during the 1997 Task Force XXI Advanced Warfighting Experiment. It was observed that the C2V provided greater mobility and protection than predecessor systems, and with more interior room allowed for better staff coordination when the staff had to operate within the command vehicle. The larger size and array of antennas also made C2V an attractive target for enemy direct-fire or close-air support systems. There were also indications that motion sickness might be a serious problem with the configuration tested. Additional testing was conducted in 1998 on three C2V variants to examine the effect on crew motion sickness. However, no difference in the frequency of motion sickness was detected among the variants.

TEST & EVALUATION ACTIVITY

In early FY00, the Army completed the full-up, system-level Live Fire Test on a complete C2V system, including all on-board communications and computers. Overall, the system was subjected to five near-miss artillery detonations, impacts on the roof by two dual-purpose improved conventional munitions and one EFP, and one scatterable anti-tank blast mine under a track. The nine test events were executed as planned, and operational checks and damage assessments were conducted immediately after each event. Army soldiers were on hand to perform troop-level battle damage assessment and repair. In addition, test firings were conducted of artillery fragment simulator projectiles at two types of weld seams to assess penetration resistance at armor joints. The Army provided a complete test report to DOT&E.

There were no OT activities conducted during FY00.

TEST & EVALUATION ASSESSMENT

Although a Live Fire assessment was not submitted to Congress due to the program's cancellation, the full-up, system-level Live Fire Test did not reveal any major vulnerability in the design of the C2V's mission module. The chassis, however, afforded less ballistic protection than the mission module, and some vulnerability flaws were found during testing.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

Live Fire Test and Evaluation efforts led to several design changes in the C2V mission module: (1) thicker monolithic armor instead of the original thinner armor with a ballistic liner; (2) more robust latches for doors and hatches using the Abrams tank hatch design; (3) increased protection around the rear door of the mission module; and (4) better mounting fasteners and inserts for the primary power-unit panel. The Live Fire Testing identified several minor flaws in the vulnerability of the Multiple Launch Rocket System chassis, upon which the mission module is mounted. In particular, the cab front and doors, door latches, and rear fuel tank showed some susceptibility to damage from artillery fragments.

CRUSADER HOWITZER AND RESUPPLY VEHICLE

Army ACAT ID Program

Total Number of Systems:	480
Total Program Cost (TY$):	$11,173.9M
Average Unit Cost (TY$):	$23.28M
Full-rate production:	4QFY08

Prime Contractor

United Defense Limited Partnership (UDLP)

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Crusader system is the Army's next-generation, 155mm, Self-Propelled Howitzer (SPH) and its companion re-supply vehicle, either tracked (RSV-T) or wheeled (RSV-W). Crusader will be the indirect fire support system for ***dominant maneuver*** armored and mechanized forces of the U.S. Army's Counterattack Corps.

The Crusader SPH will employ Advanced Solid Propellant Armament using a modular propellant charge system, auto-settable multi-option fuze, automated ammunition handling, GPS-based position location and azimuth reference system, and improved mobility and RAM. The SPH is required to deliver unassisted munitions at ranges to 30 kilometers and assisted munitions to 40 kilometers, provide a maximum rate of fire of 10 to 12 rounds per minute for 3 to 5 minutes and a sustained rate of 3 to 6 rounds per minute, have the agility and mobility to keep up with the supported maneuver force of M1 tanks and Bradley fighting vehicles, and to complete a survivability move of 750 meters within 90 seconds of identifying a potential threat. There will be an equal mix of RSV-Ts and RSV-Ws with automated ammunition and fuel re-supply functions and GPS-based navigation system. The SPH and RSV-T will each have a crew of three to replace the four and five crewmen, respectively, currently on the Paladin and the M992A1 Field Artillery Ammunition Support Vehicle. RSV(W) will have a two-man crew.

BACKGROUND INFORMATION

The Crusader SPH and RSV program, formerly the Advanced Field Artillery System (AFAS) and Future Ammunition Re-supply Vehicle (FARV) began in 1992. Crusader Operational Requirements Documents were approved in June 1993. In November 1994, the program completed a successful Defense Acquisition Board Milestone I review and entered the Program Definition and Risk Reduction (PDRR) Phase.

In March 1996, the Army decided to terminate liquid propellant development because of higher than expected technical development risks and the expectation that the solid propellant alternative could meet key performance parameter requirements at lower cost and less risk. In 1997, a decrement in program funding caused the Crusader program manager to revise the Acquisition Program Baseline (APB) and slip the Milestone II review to 2001.

In 1QFY00, the program again restructured to address software development/integration problems, a Congressional appropriations FY00 reduction, and a change in the Chief of Staff of the Army's transformation vision. Crusader re-entered the preliminary design phase to make it lighter (38 and 42 tons per vehicle) enabling both C-5s and C-17s to transport two SPHs without weight waivers. The program restructure included an RSV(W) with an automated re-supply module mounted on a PLS carrier. Crusader has also joined the Abrams program in seeking a common engine. On September 20, 2000 Honeywell Engine and Systems was selected to develop an LV100 turbine engine suitable for both systems and Allison was picked to build a X5060 transmission for Crusader. The Milestone II Review slipped to 3QFY03, with the IOT&E and FUE in 2008.

TEST & EVALUATION ACTIVITY

In August 2000, DOT&E approved a Crusader Test and Evaluation Master Plan (TEMP) that reflects the new APB and updates Crusader Critical Operational Issues and Criteria (COIC) to include criteria for platoon, battery, and battalion-level mission accomplishment. The approval memorandum requires a revised TEMP for Milestone II to update the Live Fire Test and Evaluation (LFT&E) strategy, vehicle designs, and the power train development.

Since February 2000, the Self-Propelled Howitzer-1 Emulator (SPH1E) has been undergoing checkout, propellant handling, and firing tests at Yuma Proving Ground. SPH1E includes the actual chassis, armament, and ammunition handling equipment hardware of a "heavy" Crusader prototype with emulation electronics and software, and will be used to demonstrate MS II exit criteria and Key Performance Parameters (KPP) in FY01. UDLP is integrating crew stations, armament and ammunition handling hardware, electronics, and tactical software intended for the first full-up prototypes of the heavy system into a Crusader Integrated Test Station (CITS). CITS will be used to exercise fire missions (inert charges and rounds), re-supply, upload/download, and inventory management functions for both the SPH and RSV.

In 1QFY00, prior to the Crusader program restructuring, the LFT&E IPT completed initial planning for the Live Fire Vulnerability Test activities for the EMD and LRIP periods. The proposed test program will continue to build upon the PDRR phase Engineering Development Test of Vulnerability Reduction Measures (EDT/VRM) test program by continuing component, substructure and compartmentation testing. The first full-scale structure testing of an SPH ballistic hull and turret (BH&T) and a nonfunctional mission equipment structure from a RSV(T) will be a key feature of the early EMD testing. The LFT program will culminate with a full-up, system-level test with a total of 30 firings against three operational vehicles (19 firings against two SPHs and 11 against an RSV(T)). Additional tests will involve a production-representative RSV(T) structure (similar to the early EMD SPH BH&T test). Following the restructuring of the Crusader program, DOT&E and the Army agreed to postpone further development of the LFT&E strategy until after key decisions affecting the re-design of the SPH and RSV(T), and the design of the new RSV(W) were finalized in 4QFY00.

The Crusader program continued EDT/VRM during FY00. Those activities included the Survivability Test Section (STS) experiment that simulated the effects of a propellant compartmentation event. The experiment provided engineering data to the designers of the SPH propellant bustle developing blow-off panels and compartment designs to protect the crew from fires and low-level explosions in the propellant stowage area. The EDT/VRM program is identified in the TEMP as a key element of the LFT&E strategy and will serve as a significant data source for the vulnerability evaluation.

TEST & EVALUATION ASSESSMENT

Key program management areas of concern throughout the program's life are software development, firing precision, tube wear life, nuclear survivability, and reliability. DOT&E includes performance and reliability of the laser ignition and tube cooling systems as major watch areas. Additionally, this is the first U.S. field artillery system to incorporate an automated ammunition and fuel loading and transfer system. Developing this computer-driven, mechanical system and the re-supply vehicle self-propelled howitzer docking system (a fuel and ammunition transfer boom) will be a greater challenge than developing a traditional howitzer and re-supply ammunition-handling system, and is also likely to affect Crusader's overall reliability.

Since the MS II review is scheduled before system-level prototypes of the lighter Crusader have been built or tested, we will have to rely on sub-system tests to demonstrate the exit criteria and on modeling and simulation to forecast system and force-level performance, particularly in the mobility arena. The program is attempting to maximize use of prototype sub-systems built for the original Crusader design to test key performance areas. ATEC plans to conduct an Early User Experiment (EUE) with the Crew Station Trainer and CITS to observe the soldier-machine interface, objective-path software, and ammunition handling sub-systems executing upload, rearm, and firing operations. Although CITS can demonstrate partial integration of key sub-systems, lack of prototypes will make an assessment of system integration risks and reliability more difficult.

Weight reduction initiatives include the new engine and transmission, use of new materials, reduced width and length, modular armor, and a reduced payload. Key areas to watch during the re-design and prototype development include the parallel Abrams-Crusader Common Engine and drive train development, design margin of safety, and material properties of SPH titanium armament, aluminum drive train, and composite materials components. These initiatives increase the program's technical, cost and schedule risk.

LFT&E concerns are threefold. First, a completed LFT&E plan for the re-designed system must replace the LFT&E assumptions in the current TEMP. This effort will be completed in early CY01 as more system definition takes place. Second, sufficient test assets must be programmed to assure adequate vulnerability characterization and crew survivability assessment. Finally, simulation models must be leveraged that have been adequately verified, validated, and accredited in order to maximize understanding and fill in test gaps as much as possible.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

The restructure of the Crusader program has resulted in significant changes to the T&E strategy. Without prototypes at MS II coupled with parallel development of the power pack extending into EMD, testing will focus on major sub-systems that will not be completely integrated until the full system enters EMD. Despite this challenge, the early involvement in T&E by DOT&E and ATEC has ensured that a realistic test approach was included in the restructured Crusader program and should be sufficient to test the system, barring additional major changes to the program.

ENHANCED POSITION LOCATION REPORTING SYSTEM (EPLRS)

Army ACAT II Program		**Prime Contractor**
Total Number of Systems:	4,417	Hughes
Total Program Cost (TY$):	$930M	
Average Unit Cost – Radio (TY$):	$28K	
Average Unit Cost–NCS (TY$)	$800K	
Full-rate Production:	2QFY97	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

For successful implementation of the ***Joint Vision 2020*** operational concepts of ***dominant maneuver***, ***precision engagement***, ***focused logistics,*** and ***full-dimensional protection***, enhanced command and control is essential. In anticipation of significant operational advantages, the Army recognizes that enhanced tactical communications is the first step towards achieving these goals. The Enhanced Position Location Reporting System (EPLRS) is a digital radio, and with its Net Control Station (NCS) comprises a network of individual radios that provide secure, electronic warfare resistant data communications primarily in support of the Army Battle Command System. Additionally, for the near term, EPLRS will play a vital role in the Army's modernization efforts as the communications backbone of the Tactical Internet, a critical component of the Digital Battlefield for brigade and below forces.

Major components of the EPLRS system are the EPLRS radio and NCS, which establishes and controls the network of individual radios. Each radio in the network has unique time slots during which it can transmit to both NCS and other radios. This capability is referred to as Time Division Multiple

Access, and allows NCS to process the transmissions of communications, as well as position, navigation, and identification services. The basic EPLRS radio consists of a receiver-transmitter, processor, and one of two interchangeable input/output devices. Each EPLRS radio is individually identifiable to NCS, and performs transmission (including relay), reception, and message processing functions for the situational awareness data base.

The current EPLRS system includes Very High Speed Integrated Circuit modules that increase the data rate to 56 kilobits per second (kbps) and a re-design of most of the remaining modules from the System Improvement Program (SIP). NCS has been downsized from a shelter on a 5-ton truck to a rigid-wall shelter on a High Mobility Multi-Purpose Wheeled Vehicle. The next generation of EPLRS, the Value Engineering Change Proposal, represents a departure from the MILSPEC design approach to better integrate commercial parts and practices and improve reliability while reducing cost. The new radio will be form, fit, and function compatible with the SIP version, but will reduce the current eleven circuit card assemblies to three and eliminate fifteen interconnections. It should also offer data rates in excess of 100 kbps (vs. 3.6 kbps for the SIP at IOT&E), increased network efficiency, and greater flexibility in setting up communication paths.

A typical EPLRS employment is in support of a brigade area that covers 20 by 30 kilometers, and includes approximately 170 EPLRS radios and one NCS. A division contains four of these "communities," one for each brigade and one for the division rear. The concept of employment for a brigade on the Digital Battlefield is over an area that covers 40 by 70 kilometers, and a battalion task force with brigade slice during a recent Digitization event was equipped with 158 EPLRS radios.

BACKGROUND INFORMATION

The origin of EPLRS can be traced back to July 1973, when the Department of the Army accepted an invitation from the Commandant of the Marine Corps to participate in the Position Location Reporting System Program. The Army initiated the Army Data Distribution Program as the Position Location Reporting System (PLRS) and Joint Tactical Information Distribution System (JTIDS) Hybrid Program in 1979. The PLRS and JTIDS Hybrid Required Operational Capability document, dated October 1986, contains the original requirements for EPLRS.

PLRS OT III was conducted in 1988, with many problems identified. Solutions were implemented and verified, and a full-scale production was awarded in time to equip Marine Corps forces participating in the Persian Gulf War. Although reference position limitations were revealed when survey teams had difficulty keeping up with the rapid rate of advance into Kuwait, the Marine Corps reported PLRS as having significantly enhanced their Gulf War performance in both situational awareness and free-text communications. EPLRS completed IOT&E II in December 1996. The purpose of IOT&E II was to determine the operational effectiveness and suitability of the downsized EPLRS NCS and EPLRS SIP radio.

From February 1996-March 1997, EPLRS (Tactical Internet) testing was conducted at the Electronic Proving Ground and Ft. Hood, TX, in conjunction with the Task Force XXI Advanced Warfighting Experiment. Although the level of digital connectivity observed during this experiment was low, and judged not suitable for tactical operations, the effort contributed significantly to the re-design of the Tactical Internet Architecture that will be employed on the Digital Battlefield.

EPLRS, in its role as a key component of the Tactical Internet, participated in the Force XXI Battle Command, Brigade and Below (FBCB2) Development Test-1 in May 1998 at the Electronic

Proving Ground, and the FBCB2 Limited User Test (LUT)-1 at Ft. Hood, TX, in August 1998. The Development Test-1 employed 47 EPLRS radios and included barrage and localized jamming.

TEST & EVALUATION ACTIVITY

All test and evaluation activities involving the EPLRS radio during this reporting period were within the framework of the Tactical Internet and completely aligned with the FBCB2 Program. The FBCB2 Limited User Test-2 originally scheduled for April 2000 was downgraded to a Customer Test, and LUT-2 has yet to be rescheduled.

TEST & EVALUATION ASSESSMENT

The data from IOT&E II and the previous operational tests for EPLRS were sufficient to conclude that the current version of EPLRS, the downsized NCS, and the SIP radio effectively disseminate short data messages such as those used in the air defense application. The data were not sufficient to demonstrate effectiveness for long messages. Results from Army Tactical Command and Control System testing indicate that approximately fifteen percent of its traffic included messages longer than those examined during IOT&E. While the jamming environment did reduce the message completion rate, the system performed well overall. IOT&E II also provided sufficient data to confirm that EPLRS is operationally suitable. Testing of the new Value Engineering Change Proposal radio should include longer messages at higher data rates with interoperable host systems.

In its Tactical Internet role, and in conjunction with the Single Channel Ground and Airborne Radio System radio and Internet Controller, the data collected during the 1997 Force XXI Advanced Warfighting Experiment indicated that the Tactical Internet message completion rate and speed-of-service were below expectations. Development Test-1 results demonstrated significant improvements over experimental results: command and control message completion rates increased from approximately 30 to 80 percent, and speed of service decreased from approximately 3 minutes to less than 4 seconds. Although these results were reflective of performance in a technical environment, similar improvements were also observed during the more operationally realistic LUT-1, albeit with a smaller network than in the Advanced Warfighting Experiment. Whether these results are "scalable" from a battalion task force to a brigade task force was to be examined during the FBCB2 Limited User Test-2/Force Development Test and Experimentation in April 2000. However, due to software development and integration challenges within the Army Battle Command System, this Limited User Test was cancelled and has yet to be rescheduled. An excursion during the Customer Test examined transmission of FBCB2 and air defense data over the same EPLRS needline network, and found that the bandwidth was not sufficient to meet the 4 second update rate for air tracks.

Testing and evaluation from FY01-02 for the FBCB2 Program will determine whether EPLRS can adequately support the Tactical Internet requirements of the Digital Battlefield.

FAMILY OF MEDIUM TACTICAL VEHICLES (FMTV)

Army ACAT IC Program

Total Number of Systems:	83,170
Total Program Cost (TY$):	$18B
Average Unit Cost (TY$):	$167K
Full-rate production:	FY95

* $135.0K in FY96 constant dollars based on a weighted average of 16 models

Prime Contractor
Stewart & Stevenson

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Family of Medium Tactical Vehicles (FMTV) consists of fourteen variants of tactical wheeled vehicles based on a common truck cab, chassis, and internal components and two tactical trailers. The components are primarily non-developmental items integrated in rugged tactical configurations. The light-medium tactical vehicles are 2.5-ton payload capacity models consisting of cargo, airdrop cargo, and van variants. The medium tactical vehicles are 5-ton payload capacity models consisting of cargo (with and without material handling crane), long wheel base cargo (with and without material handling crane), airdrop cargo, tractor, wrecker, dump, airdrop dump, water tanker, and expansible van variants. The 11,437 trucks produced to date are designated the A0. The Army approved an anti-lock braking system, integrated data bus, and an Environmental Protection Agency 1999 compliant engine for production as model A1.

FMTV supports ***Joint Vision 2020*** objectives: ***focused logistics*** through the transport of troops, water and ammunition distribution, and general cargo transport; and ***information superiority*** by providing mobility of shelters that contain the new generation of automated systems, sophisticated management information systems, and communications links. FMTV also supports ***precision engagement*** as the prime mover for towed artillery and as the chassis for the High Mobility Artillery Rocket System (a Multiple Launch Rocket System derivative on a wheeled chassis).

BACKGROUND INFORMATION

The acquisition strategy includes the LRIP award in October 1991 for 10,843 vehicles. There was a deferred production and separate R&D effort for companion trailers (2.5- and 5-ton) and a medium tactical vehicle expansible van. The Army made the full-rate production decision for the A0 trucks in August 1995. The Army made a production decision on September 9, 1999 for a minimum of an additional 1,552 vehicles. The second source program has undergone significant revision in FY00. It is now being called the FMTV Competitive Re-buy and is a two-phase program. The first phase is a competitive down-select in FY01. The second phase is a multi-year production contract to be awarded in FY02. The FUE for the production vehicles from the second source contractor is scheduled for FY05.

Operational testing was conducted at Ft. Bragg, NC, in three phases: *Phase I*, September-December 1993, was terminated for poor demonstrated reliability. *Phase II*, conducted June-November 1994, was interrupted and cancelled when the soldiers of the test unit deployed to Haiti. *Phase III*, conducted April-July 1995, was the basis of the DOT&E B-LRIP report.

While the system proved effective and suitable, there were certain safety deficiencies detailed in the report to Congress that needed to be corrected before fielding. The Army made the corrections and confirmed the fixes in an abbreviated operational assessment performed in December 1995.

While FMTV was found to be effective and suitable in operational testing in temperate zones, technical testing under arctic conditions uncovered starting and braking problems and seal leaks. These problems have been fixed and their solutions confirmed with the testing of an A1 wrecker and medium cargo truck in arctic conditions at Ft. Greely, AK, in early 1999.

In early 1998, there were several field incidents (subsequently replicated at Aberdeen Proving Ground) in which the front U-joint on the rear driveshaft of the 2.5-ton variants failed. This failure causes the driveshaft to whip around, severing air-brake lines (which, by design, locks the brakes). Investigation by the Army uncovered a previously unknown driveline resonance that occurs on paved roads at sustained speeds in excess of 40 miles per hour. The Army issued a Safety of Use Message to limit truck operations to 30 mph or less. The solution was a more robust flywheel housing design cast out of nodular iron and a less flexible driveshaft with a more sturdy U-joint design. During this past year, fielded A0 trucks were retrofitted with the power train solution and lifted the 30 mph restriction.

Production Verification Testing (PVT) of the A1 model truck in FY98-99 uncovered several additional problem areas, and new performance and reliability issues arose: leaf spring breaks, electromagnetic interference from the new engine electronic control module, and frame integrity. A new manufacturing process has been developed and tested to remove the cracking centers that lead to leaf spring breaks. The electronic interference has been found to not adversely affect electronic equipment carried on FMTVs. The frame rails on FMTVs manufactured starting in Program Year 3 (Vehicle 1553 and beyond) are being manufactured from higher strength steel without changing truck handling or load carrying characteristics. On older trucks, the user has accepted the risk that the stresses needed to deform the frame are sufficiently infrequent to be tolerable.

The House Appropriations Committee's Survey and Investigation (HAC S&I) team visited Ft. Bragg in 1999, and received numerous complaints about FMTV dump truck capacity and performance and certain other human-engineering features of the FMTV. The PM instituted fixes to address the complaints and established a soldier feedback mechanism to both encourage soldier input and keep the soldiers informed of changes being made. The suspension system and bed of the dump truck are being strengthened to accommodate loads beyond five tons.

DOT&E approved the FMTV TEMP on July 1, 1999.

TEST & EVALUATION ACTIVITY

OT&E activity in FY00 consisted of an evaluation of an A1 model Maintenance Demonstration and Interactive Electronic Technical Manual verification and user testing of the remaining variants in late FY00. Follow-on Production Testing (FPT) will begin in August 2000 (at Yuma Proving Ground) and November 2000 (at Aberdeen Proving Ground).

There was extensive developmental testing of the proposed fixes for the flywheel housing and driveshaft failures. The final designs were successfully tested and are being retrofitted worldwide. At this time, only two trucks out of the original 11,437 are left to be retrofitted once they are located. Other issues that arose out of PVT were also component tested and underwent successful modeling and simulation. Contractor system-level testing of springs and frames are scheduled to begin in September 2000. The FPT beginning in November 2000 will be the first government test at the system level.

TEST & EVALUATION ASSESSMENT

The operational test of FMTV in 1995 was adequate to provide the information necessary to determine its operational effectiveness and suitability given the user defined mission profile. This mission profile for the truck models is defined to be 20 percent on primary roads, 50 percent on secondary roads, 15 percent on trails, and 15 percent on cross-country. The operational testing was carried out in as realistic an operational environment as could be achieved within the constraints of available test ranges, resources, and safety. The test fleet drove more than 200,000 miles. FMTV is operationally effective based upon the demonstrated fleet-wide probability of mission success of 0.96.

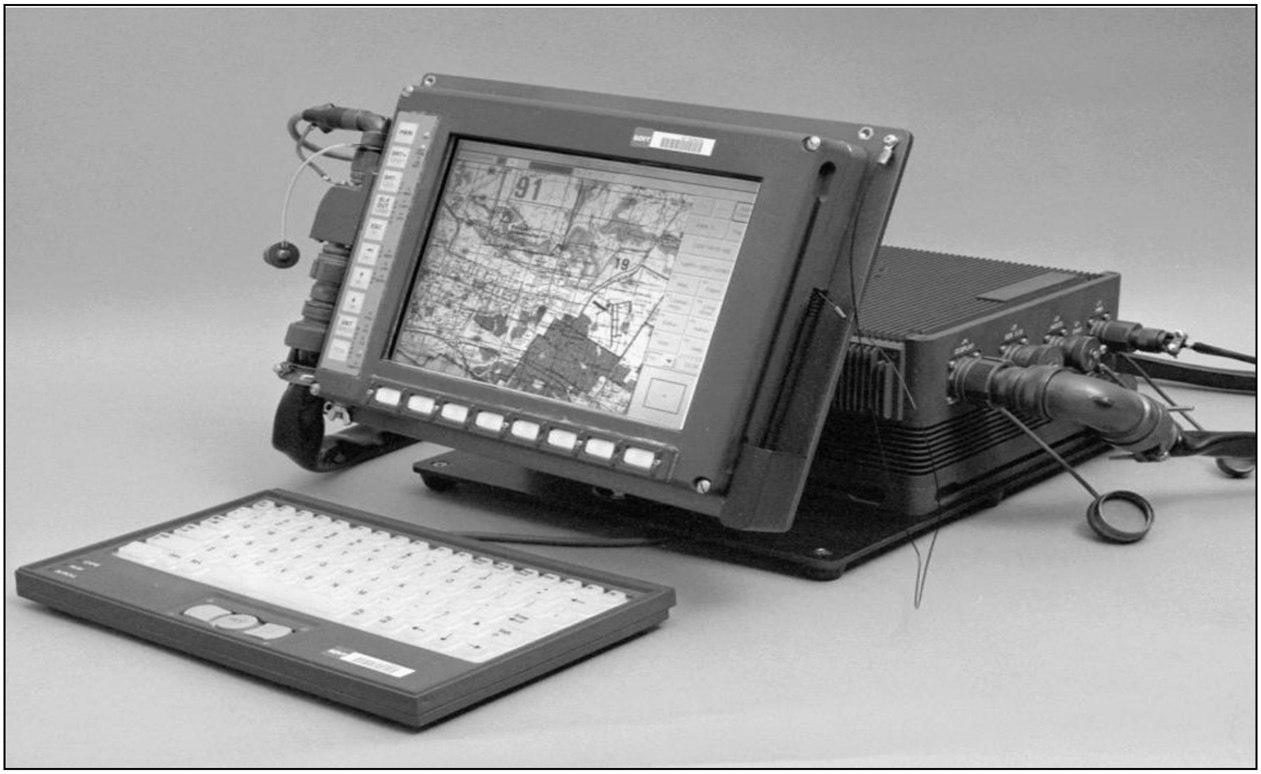
Overall, FMTV is operationally suitable as tested in 1995. The tested FMTV fleet demonstrated better than the required reliability and operational availability. Based on test results, the trucks required less maintenance than allowed.

The failure modes of the flywheel housing and driveshaft have not recurred and the leaf spring, electromagnetic interference, and frame integrity issues appear to have been resolved.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

Many of the HAC S&I findings, based on complaints from soldiers, were also observed during operational testing. The program office agreed to fix 54 complaints. Complaints regarded as "nuisance" failures, not related to vehicle reliability, were not corrected. Such problems condition the soldiers' attitude towards and respect for his equipment. The perception that the vehicle has lots of problems will result in abuse and failure to properly care for equipment. Much more attention must be paid to soldier complaints during operational testing prior to deployment.

FORCE XXI BATTLE COMMAND, BRIGADE AND BELOW (FBCB2)



Army ACAT ID Program

Total Number of Systems:	59,522	
Total Program Cost (TY$):	$1.8B	
Average Unit Cost (TY$):	$27K	
Full-rate production:	FY02	

Prime Contractor
TRW

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

Two important components of the Army's Battle Command System and the Battlefield Digitization effort are the Force XXI Battle Command, Brigade and Below (FBCB2) program and its supporting Tactical Internet. FBCB2 is a digital, battle command information system intended to provide commanders, leaders, and soldiers—from brigade to individual soldier, and across all the Battlefield Functional Areas—improved command and control and enhanced situational awareness information. FBCB2 primarily consists of software, but will also include a ruggedized computer for those users and platforms without an existing computer system. Systems with existing computers capable of hosting FBCB2 software will receive the Embedded Battle Command software—a sub-set of FBCB2—and additional hardware as necessary. Embedded systems for the near term include the M2A3 Bradley Fighting Vehicle, the M1A2 SEP ABRAMS Tank, and the Army Tactical Command and Control Systems (ATCCS).

FBCB2's primary functions are to send and receive automatic position location reports derived from its interface with the Global Positioning System, and to send and receive command and control message traffic via digital over-the-air radio transmissions. The Tactical Internet is the network of radios and routers that provide linkages to connect the myriad FBCB2 platforms (both vertically and horizontally) across the combined arms force. The Tactical Internet consists of the Enhanced Position Location Reporting System, the Single-Channel Ground and Airborne Radio System, and the Internet Controller router.

FBCB2 and the Tactical Internet perform as a network within brigade-sized and smaller units. At the Brigade and Battalion Tactical Operations Centers, the Tactical Internet interfaces with ATCCS, an Ethernet-based local area network of computers representing the functional areas of intelligence, maneuver, air defense, combat service support, and fire support. This interface permits information collected and disseminated via ATCCS systems to be rapidly passed through the Tactical Internet to FBCB2 computers. Likewise, the position reports of individual and unit locations are passed upwards through the FBCB2 and Tactical Internet into the ATCCS system for dissemination throughout the force. The FBCB2 and Tactical Internet help provide ***information superiority*** to the ***dominant maneuver force***. The basis for the new operational concepts in ***Joint Vision 2020*** is improved command and control.

BACKGROUND INFORMATION

The Army initiated the Force XXI Battlefield Digitization program in 1994, with the intent to proliferate and integrate digital communications and information management technologies across the combined arms spectrum. The Army's efforts have been demonstrated in a series of Advanced Warfighting Experiments (AWEs). The central hypothesis throughout Digitization experimentation has been**: "If information age, battle command capabilities and connectivity exist across all battlefield operating systems, then increases in lethality, survivability, and op tempo will be achieved**." The first AWE to examine FBCB2 was Task Force XXI, conducted June 1996-March 1997, with the culminating event at the National Training Center.

The Task Force XXI AWE equipped a brigade from the 4th Infantry Division with FBCB2 (Appliqué) hardware and software on all of its 1,600-plus vehicles. The brigade trained with the new digital equipment, among dozens of other initiatives, for about eight months, then deployed to the National Training Center for a series of force-on-force battles with a live opposing force. Due to immaturity of the FBCB2 and Tactical Internet, the degree of digital connectivity achieved during the Task Force XXI AWE was not sufficient to achieve the premise of the central hypothesis and not suitable for tactical operations. The immaturity also impacted the training readiness of the unit and development of Digital Tactics, Techniques, and Procedures (TTPs). In spite of these challenges, the digitized brigade performed similarly to the non-digitized baseline brigades at the National Training Center, a result that, with follow-on constructive modeling, the Army used to support continued program acceleration.

A conditional Milestone I/II decision for FBCB2 was made in July 1997, pending completion and approval of the FBCB2 TEMP and ORD. The Joint Requirements Oversight Council approved the ORD in August 1998, but the TEMP was not approved by OSD until December 1999. The Army Milestone Decision Authority (the Program Executive Officer) directed that FBCB2 transition from an Acquisition Category (ACAT) III program to ACAT II at the July 1997 review. In spring 1999, when the ACAT I dollar threshold was exceeded, the Army Acquisition Executive recommended that FBCB2 be re-designated as an ACAT IC. In September 1999, the Defense Acquisition Executive determined that the programmatic challenges of FBCB2 warranted its designation as an ACAT ID program.

The most recent operational testing of FBCB2 and the Tactical Internet was conducted in FY98. Limited User Test (LUT)-1 was conducted at Ft. Hood with a Battalion Task Force of 232 platforms equipped with FBCB2. An opposition force was included to operationally stress the unit's employment of FBCB2, and passive electronic warfare monitoring was conducted. FBCB2 software tested during LUT-1 lacked several critical capabilities called for in the ORD requirement, and as a result of poor quality control during computer hardware assembly, many heat-related failures were experienced. Nonetheless, FBCB2 system performance during LUT-1 represented a significant improvement over that observed during the Task Force XXI AWE. The friendly situational awareness information provided by FBCB2 and the new Tactical Internet architecture was generally accurate and timely, and the improved system stability permitted soldiers to employ FBCB2 information during the execution of their missions. The stability also permitted the test unit to achieve a higher state of training than the Task Force XXI unit, and furthered the refinement of Digital TTPs.

A Reliability Demonstration Test (RDT) was conducted from June-July 1999 to demonstrate that commercially available technology and improved quality control in the manufacturing process could alleviate a large percentage of heat-related hardware failures experienced during LUT-1. A large increase in the number of hours between essential function failure was observed at the RDT when compared to LUT-1 results, but a comparable demonstration during an OT is required to determine that the improved performance can be reproduced in the operational environment when employed by soldiers. In addition to improved quality control, a re-configuration of the FBCB2 computer's internal components is planned to improve the heat transfer away from heat-sensitive components. It should also be noted that the RDT results did not factor in failures of non-FBCB2 equipment critical for FBCB2 to be effective, and that there is currently no system-of systems reliability requirement for FBCB2.

The first briefing of the SEP by the Army in December 1998 resulted in DOT&E rejection of the plan due to shortfalls that would preclude FBCB2 from being adequately tested. As outlined in a December 22, 1998 DOT&E memorandum, FBCB2 testing must be conducted in an operational system-of-systems environment with live force-on-force events comparable to an analog baseline supporting the force-effectiveness evaluation. In June 1999, the Army proposed a restructured FBCB2 Program with heavy system-of-system digitization emphasis. The revised T&E strategy included a force effectiveness evaluation at the National Training Center, (LUT-3), with three baseline events identified for comparison. The revised strategy also added 25 months to the schedule to ensure appropriate hardware and software maturity prior to IOT&E. The revised strategy was favorably received by DOT&E.

As the FBCB2 program was restructured, there was increased emphasis on the role of the Army Battle Command System (ABCS) hardware and software. Under the revised architecture, FBCB2 hardware will not be present in Tactical Operations Centers: situation awareness information will be processed by Embedded Battle Command software, and command and control functions (messages, orders, overlays, etc.) will be performed by ABCS software, both hosted on ATCCS workstations. Therefore, any testing that includes units above the company level must include ATCCS systems and requisite interoperability between FBCB2 and ABCS software. This resulted in the requirements that spiral development of FBCB2 must coincide with the multiple spiral developments of all the Battlefield Digitization programs, an enormous challenge for configuration management of software, testing, evaluation, and acquisition reform.

TEST & EVALUATION ACTIVITY

Scheduled FBCB2 testing in FY00 included Field Test-2 (a developmental test) and a combined LUT-2/Force Development Test and Experiment, where performance of FBCB2 and ABCS systems were to be examined and critical tactics, techniques, and procedures for the Digital Battlefield were to be validated. As a result of immature ABCS software, the field test was repeatedly slipped and conducted without meeting entrance criteria over three phases from December 1999-March 2000. The Army downgraded LUT-2 to a Customer Test (CT) when it became clear that LUT-2 entrance criteria could not be achieved; and CT was conducted in April 2000. Although not technically an operational test, the CT was essentially the same test as planned when designated a LUT-2, at approximately the same cost. For the remainder of FY00, the FBCB2 T&E Strategy was under revision, and the Army attempted to preserve the approved TEMP. The Army was not able to accomplish LUT-2 objectives before October 2000, when the next phase of testing was scheduled to begin, so a new TEMP is now required.

The latest draft strategy for FBCB2 has Field Test-3 scheduled to begin in January 2001, and this field test may be followed by LUT-2 in April 2001 (at the National Training Center) in conjunction with the Division Capstone Exercise. Later in FY01, production-representative systems are scheduled for examination in Field Test-4 to determine their readiness for FBCB2 IOT&E in November 2001.

TEST & EVALUATION ASSESSMENT

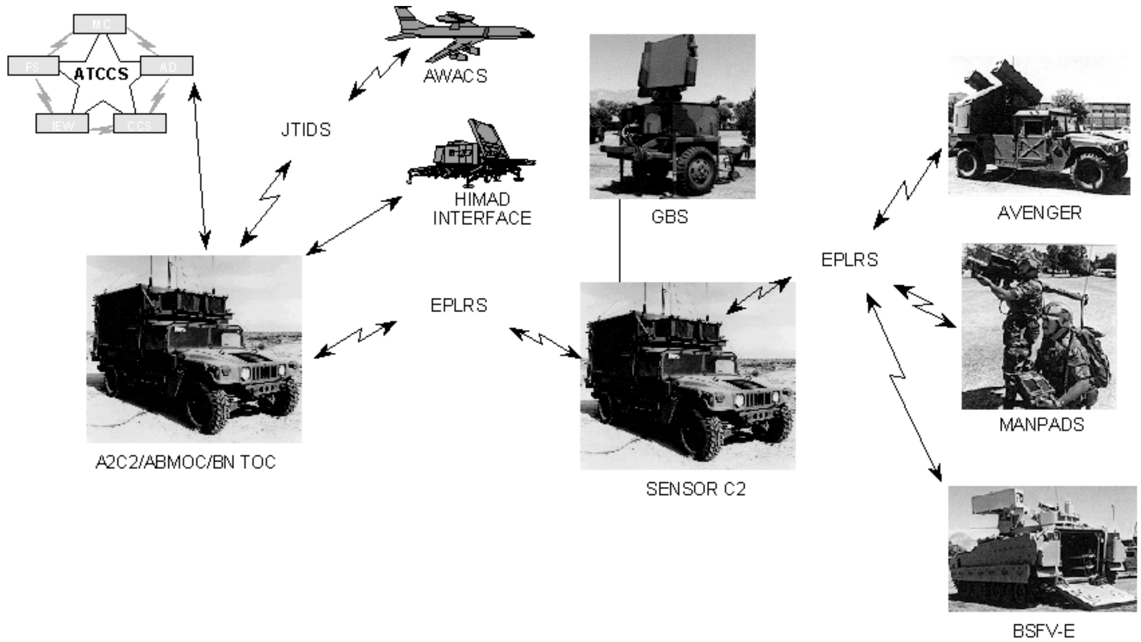
The most recent information regarding FBCB2 operational performance is based on the LUT-1 conducted in August 1998 and April 2000 CT. Significant improvements over the Task Force XXI AWE results were demonstrated at LUT-1, albeit with smaller networks: command and control message completion rates increased from approximately 30 to 80 percent, and speed-of-service was improved from approximately 3 minutes to less than 4 seconds. Situational awareness message completion rates rose from 25 percent to nearly 65 percent, and speed-of-service decreased from approximately 1 minute to less than 8 seconds. Qualitative information indicated that the use of FBCB2 assisted commanders in control of maneuver and synchronization of combat power. An example of this occurred during LUT-1, when two companies successfully performed a passage of lines over difficult terrain, a feat that the battalion commander stated he would not have attempted without FBCB2. Other observations indicate that situation awareness provided by FBCB2 permits commanders to focus more of their time on actually commanding, as less time is required to track positions and movement.

Performance at the FBCB2 CT was similar to that of LUT-1 for command and control and situation awareness message completion rates—a positive indicator as the CT employed two battalion task forces and two brigade headquarters as compared to one of each for LUT-1. However, the speed of service degraded to 30 to 60 seconds for friendly situation awareness messages. These results leave open the question of "scalability," or whether the Tactical Internet will be able to support the greater demands of division-sized network. ABCS functionality that was immature and lacked stability during Field Test-2 proved ineffective at developing and disseminating operational orders and overlays during CT, hindering the attainment of the Common Tactical Picture and prosecution of the maneuver battle.

As we stated in last year's Annual Report, current FBCB2 capabilities are immature, with a number of critical enhancements needed to achieve an effective and suitable capability. These enhancements include a robust network management capability to monitor the network's health and respond to identified problems, interoperability with Army Tactical Command and Control Systems, and rapid re-establishment of the network when communication/combat losses occur or a task organization change is required. Digital Tactics, Techniques, and Procedures will also be critical to the success of a digitized force, and at this time remain poorly developed to take optimum advantage of existing digital capabilities.

We remain concerned that the pressure to achieve the Army's goal of First Digitized Division by the end of 2000—and the Division Capstone Exercise in April 2001—may result in expediencies that are not in the best long-term interest of the Battlefield Digitization effort. This occurred during the FY00 test schedule when the delivery of required functionality did not occur in time to adequately conduct preliminary risk-reduction or training events, yet scheduled testing was still conducted. Although the Army may state that "Go To War" capability exists at the conclusion of the Division Capstone Exercise, DOT&E will only consider FBCB2 operationally effective and suitable when it provides enhanced military capability in the non-benign, system-of-systems environment across the array of climates and scenarios. There is significant potential for FBCB2 to contribute to improved unit performance on the Digital Battlefield, wherever that may be, but this will only be realized through disciplined development, experimentation, testing, and performance evaluation across all appropriate employment scenarios.

FORWARD AREA AIR DEFENSE COMMAND, CONTROL, COMMUNICATIONS, AND INTELLIGENCE (FAAD C^{3}I) SYSTEM



Army ACAT IC Program		**Prime Contractor**
Total Number of Systems:	15	TRW
Total Program Cost (TY$):	$1,149M	Hughes
Average Unit Cost (TY$):	$76.6M	
Full-rate production:	3QFY95	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Forward Area Air Defense Command, Control, Communications, and Intelligence (FAAD C^{3}I) system is a network that connects the command posts, weapons, and sensors of the Army's short-range air defense units. In addition, the FAAD C^{3}I system is one of the five components that make up the Army Tactical Command and Control System. The Ground-Based Sensor (GBS), also called Sentinel, provides air surveillance, target acquisition, and target tracking information to the weapons in the FAAD Battalion. The FAAD C^{3}I and the Sentinel radar provide ***information superiority*** to help ensure a ***dominant maneuver*** force.

The FAAD C^{3}I system consists of computer hardware, computer software, and communications equipment. The computer hardware includes central processing units and display screens. FAAD C^{3}I software performs air track and battle management processing functions. The communications equipment consists of the Single-Channel Ground and Airborne Radio System, the Joint Tactical Information Distribution System, and the Enhanced Position Location Reporting System. In essence, FAAD C^{3}I is an automated system that provides command, control, targeting, and other information to air defenders on the battlefield. The Sentinel TPQ-36A radar is a modified version of the Army's FIREFINDER counter-battery radar. Sentinel is a three-dimensional radar system that uses a phased-array antenna and an Identification Friend or Foe device. The GBS system is mounted on a High Mobility Multi-Wheeled Vehicle and a towed trailer.

BACKGROUND INFORMATION

The first operational test of the FAAD C^3I system was the Limited User Test in January and February 1993 at Ft. Bliss, TX. The Army made an LRIP decision to procure and field the FAAD C^3I system to one light division, the 101st Air Assault Division, following the FAAD C^3I Limited User Test.

FAAD C^3I and GBS IOT&E was conducted from September-December 1994 at Ft. Hood and Ft. Bliss. Testing at Ft. Hood assessed the capacity of the FAAD C^3I system to interoperate with other components of the Army Tactical Command and Control System. During testing at Ft. Bliss, command and control information, as well as air track data collected from the GBS radar and other sensors, was passed throughout the FAAD C^3I system.

FAAD C^3I and GBS IOT&E was adequate to assess operational effectiveness and suitability. Baseline testing using the Army's current air defense capabilities was also conducted during IOT&E. Thus, direct comparisons of the test results could be made between the FAAD C^3I and GBS systems and the baseline despite inherent test limitations.

A major finding from IOT&E was that when there were no friendly aircraft flying, FAAD C^3I and GBS clearly demonstrated improvement over the baseline system, and were considered to be effective. However, when friendly aircraft were added to the operational scenario, fratricide experienced by both the baseline and FAAD C^3I units was unacceptably high, making FAAD C^3I useful only when friendly aircraft were not present or as a self-defense system. The FAAD C^3I and GBS systems were judged to be operationally suitable, although there were shortfalls in the generator and software reliability of the GBS system and mobility issues in both the FAAD C^3I and GBS systems.

A new version of FAAD C^3I software, version 4.R, was tested in an Early User Innovative Test at Ft. Bragg, NC, in June 1997. The version 4.R software is a re-hosting of current FAAD C^3I software on the Army's next-generation Common Hardware and Software-2 hardware, replacing the current Common Hardware used by FAAD C^3I. Additional regression testing of version 4.R FAAD C^3I testing followed the Early User Innovative Test. The reliability problems discovered in IOT&E and associated with the GBS radar sub-system were fixed and successfully tested during the 1997 Performance Verification Test. This test also revealed a design flaw in the high mobility trailer used to transport the GBS system (which makes the trailer unsafe.) The Army identified an interim solution and a materiel release was issued in November 1998.

The latest software of the FAAD C^2I system is version 5.2. The most significant upgrade of version 5.2 is the re-host of FAAD C^2I software on Force XXI Battle Command, Brigade and Below (FBCB2) hardware. The FBCB2 V3 handheld computer will display either the air defense picture provided by FAAD C^2I or the ground picture provided by FBCB2. This requires that FAAD C^2I and FBCB2 transmit data over the same EPLRS needline network to the FBCB2 V3 computer.

TEST & EVALUATION ACTIVITY

Testing of the FAAD C^3I system during FY00 consisted of Phase I of the Limited User Test of the version 5.2 FAAD C^2I system. Phase I testing was conducted in conjunction with the FBCB2

Customer Test (CT) at Ft. Hood in April 2000. The primary objective was to examine the co-hosting of FAAD C^2I and FBCB2 data transmissions over the same EPLRS network (needline competition) and the ability to display both the air picture and ground picture on the same FBCB2 computer.

Phase II of the Limited User Test (LUT) will be conducted in conjunction with PATRIOT PAC-3 IOT&E scheduled for late FY01. The LUT will support the materiel release and fielding decisions for Version 5.2 software.

TEST & EVALUATION ASSESSMENT

The FAAD C^3I and GBS systems significantly enhance the accomplishment of low altitude, short-range air defense missions when compared to previous capability. The ability of STINGER-equipped units to engage hostile aircraft at longer ranges, particularly before ordnance release, offers greatly improved protection of friendly ground units. However at longer ranges, positive identification of "unknown" aircraft is more difficult, and fratricide, as observed during IOT&E, becomes a serious problem. During IOT&E, friendly aircraft were frequently engaged by friendly air defense fire units because the aircraft were identified as "unknown" to individual air defense gunners. This situation is operationally realistic and exists due to the inability of today's electronic identification devices to identify all friendly aircraft correctly. Thus, soldiers must perform visual identification of all "unknown" aircraft as either "friend" or "foe." Until such time as a highly reliable means of identification is available, FAAD C^3I will most commonly operate in the more restrictive "weapons tight" or "weapons hold" postures. All future OT of FAAD C^3I and GBS should examine the important issue of fratricide and employ both friendly and hostile aircraft. The next FAAD C^3I operational testing to examine fratricide issues will be Phase II of the FAAD C^3I LUT scheduled for 2001.

Future operational testing should also examine whether FAAD C^3I and GBS systems can keep up with the maneuver force during highly mobile combat operations such as Operation Desert Storm. Additionally, the reliability problem with the GBS high mobility trailer is still an open issue; the Army continues to operate with a workaround and an interim safety release.

There were two primary issues for FAAD C^2I to be addressed during Phase I of the FAAD C^3I LUT. The first issue was the Tactics, Techniques, and Procedures (TTPs) for soldiers operating the FAAD C^2I system on the same computer as the FBCB2 system. In essence, TTPs need to be developed for soldiers using both the FAAD C^2I air picture and the FBCB2 ground picture. The second issue was whether there was sufficient bandwidth so that air track data could meet the 4-second update rate required to effectively operate the slew-to-cue capability of AVENGER and LINEBACKER air defense fire units. The preliminary results suggest the soldiers liked the concept of having both the air and ground pictures on a single computer.

FAAD C^3I upgrades and interoperability associated with its role in the Army Battle Command System Version 6 will be examined during Force XXI Battle Command, Brigade and Below testing during FY00-02. A revision of the FAAD C^3I TEMP is in staffing, and the test plan for Phase II of the LUT is expected soon.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

The fratricide problems identified during IOT&E would not have surfaced if operationally realistic combat identification and engagement procedures had been excluded. Previous testing, such as the Limited User Test in 1993, did not exhibit high fratricide rates because testing only examined the ability of the FAAD C^3I system to pass information around the battlefield. The Limited User Test held in 1993 did not require Army gunners to use FAAD C^3I information to complete an engagement.

GRIZZLY

Army ACAT II Program

Total Number of Systems:	366
Total Program Cost (TY$):	$3,108M
Average Unit Cost (TY$):	$7.4M
Full-rate production:	1QFY03

Prime Contractor

United Defense Limited Partnership (UDLP)

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Grizzly is an armored vehicle that provides an in-stride capability to overcome simple and complex linear obstacles. The system is designed to breach obstacles, including mines, rubble, berms, wires, and ditches to create a safe lane for other vehicles in the maneuver force. The Army currently has no other system with these capabilities. The Grizzly will be fielded in division and selected corps engineer battalions, and supports the ***Army Vision 2020*** concepts of ***protect the force*** and ***decisive operations***.

The Army based the Grizzly design on the Abrams M1 chassis, equipped with a full-width, mine-clearing blade, and a power-driven excavating arm. While buttoned up, a crew of two should be able to operate all sub-systems. The vehicle contains electric drives, an advanced open system vehicle electronic architecture, automatic depth control for the mine clearing blade, and provisions for digital battlefield command and control.

BACKGROUND INFORMATION

The Army's Acquisition Executive notified OSD that the Army designated the Grizzly program as an ACAT II program and a covered system for LFT&E in a memorandum dated June 4, 1996. The Grizzly was added to the FY97 Annual T&E Oversight List for LFT&E only.

The Grizzly program was initiated in FY92 as a result of lessons learned during Operation Desert Storm. The Army leveraged the work conducted under an Advanced Technology Demonstration Program. A sole-source contract was awarded to United Defense Limited Partnership in September 1992 for DEM/VAL. Prototypes were delivered in 4QFY95. Early user experiments were conducted in February 1996, and a blade performance testing using automatic depth control was completed in November 1996. The program Milestone II decision was made in December 1996, and the program proceeded through the design maturation phase of EMD in 1999.

TEST & EVALUATION ACTIVITY

As the Grizzly proceeded through the design maturation phase of EMD, T&E activity focused on the emerging configuration of the vehicle and its sub-systems, as well as the scope of T&E required to assess the system's overall effectiveness, suitability, and survivability.

Production Qualification Test Phase-I (PQT-I) began in FY98, with tests to support design decisions for the Grizzly automatic fire suppression system (AFSS). These tests utilized a full-scale mock-up of the Grizzly sub-floor compartment and internal components to evaluate AFSS effectiveness at preventing or suppressing fire and explosion after the vehicle is hit by a threat weapon. The tests also supported nozzle design and placement decisions.

PQT-I continued in FY99, with live fire tests of a full-scale Grizzly Ballistic System Structure (BSS) replicating the Grizzly hull, crew station, and mine clearing blade. BSS test objectives included demonstration of the suitability of armor designs, hatches, vision devices, shielding for exposed hydraulics and electronics, and fabrication techniques. Ballistic threats tested between April-July 1999 included small arms, rocket-propelled grenades, kinetic energy projectiles, anti-tank guided missiles, direct-fire high-explosive projectiles, mines, and fragmenting artillery shells. The selected threats addressed system requirements and explored the ballistic limits of the Grizzly design.

Following the program budget decision in December 1999 that designated Grizzly for termination, the Army conducted limited mine-clearing performance testing of two EMD prototypes. No further live fire testing was conducted during FY00. Minimal contractor and program office work continues while awaiting final program disposition. The Army Engineering School is exploring courses of action to address assault gap breaching requirements without Grizzly.

Although the Army has described the Grizzly as one of its principal unfunded requirements, it has not designated the Grizzly for future funding in the Army program objective memorandum for FY02-FY07. Final defense authorization and appropriation bills provided no further FY01 funding.

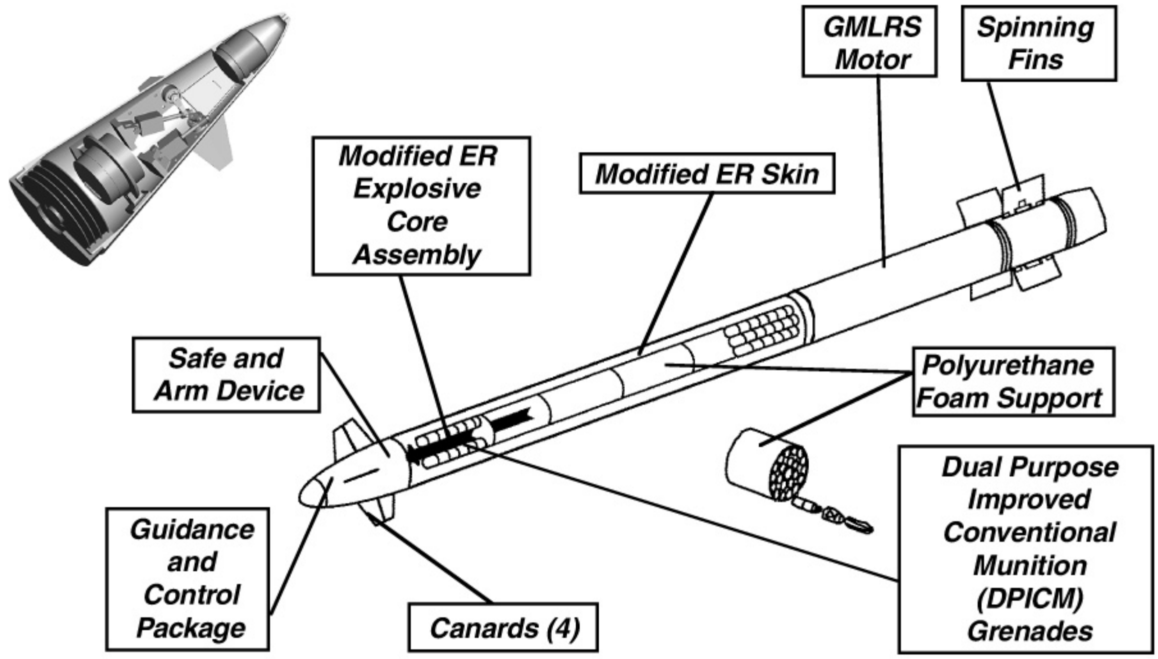
TEST & EVALUATION ASSESSMENT

The FY99 Grizzly BSS live fire test generally demonstrated resistance to penetration and overall structural integrity of the fabricated armor shell, and met multi-hit requirements. Observed vulnerabilities of specific components initiated design reviews to explore fixes or alternative designs.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

The BSS test revealed specific vulnerabilities of external cables, hydraulic lines, the tactical depth sensor, and external video cameras for crew visibility. Contractor and government engineers were to consider possible solutions to the observed vulnerabilities. If the Grizzly program is re-established, such design efforts should build upon the test, evaluation, and related design work accomplished to date.

GUIDED MULTIPLE LAUNCH ROCKET SYSTEM (GMLRS) ROCKET



Army ACAT IC Program

Total Number of Systems (Army Procurement Objective):	83,922
Total Program Cost (TY):	$3.6B
Average Unit Cost (TY):	$43K
Ave Unit Procurement Cost (TY):	$41K
Full-rate Production:	2QFY06
Low-rate Production:	3QFY03

Prime Contractor

Lockheed Martin Missile and Fire Control – Dallas, TX

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Guided Multiple Launch Rocket System (GMLRS) rocket is an enhanced version of the current MLRS Extended Range (ER) rocket. The GMLRS rocket, like the ER and the basic M26 MLRS rocket, is designed to be used against soft and lightly armored stationary targets. The overall length and diameter have not changed. As with the current rockets, an MLRS launcher will carry twelve GMLRS rockets configured in two six-rocket Launch Pod Containers (LPC).

The GMLRS rocket has a range in excess of 60 kilometers, compared to the ER rocket's 45 kilometers. The ER rocket increased its range compared to the M26 rocket by reducing the bomblet load from 644 to 518 and increasing the amount of propellant. Range for the GMLRS rocket is further extended by changing the rocket motor design to increase burn time and total motor impulse. The number of bomblets will be reduced from 518 to about 400.

The GMLRS rocket includes a Global Positioning System (GPS)-aided inertial guidance and control unit, intended to produce accuracy of 2 to 3 mils with inertial-only guidance and less than 15 meters circular error probable (CEP) with GPS.

The ER and GMLRS rockets were intended to carry a modified bomblet to reduce the number of hazardous duds on the battlefield. The basic M26 rocket carries Dual Purpose Improved Conventional Munition (DPICM) M-77 bomblets. The modified ER and GMLRS bomblet, the M-85, had the same bomblet body but had a redundant fuzing system with the addition of an electronic self-destruct device. The modifications were not expected to affect the bomblet's lethality. As explained in the Assessment section below, producibility problems have led to a search for other self-destruct designs.

The GMLRS rocket provides commanders an operational fires capability for ***precision engagement*** of the enemy throughout the depth of the battlefield beyond the range of the currently fielded cannons and rockets. The targets include soft and lightly armored combat vehicles, multiple rocket launchers, towed artillery, air defense units, and command/control/communications sites. The ER and GMLRS rockets' ability to engage the enemy at extended ranges supports the ***Joint Vision 2020 dominant maneuver*** force by helping the commander shape the battlespace.

BACKGROUND INFORMATION

The need for the ER and GMLRS rockets is based on the experiences of Operation Desert Storm and the continued threat of the proliferation of longer-range artillery systems. ER-MLRS is an ACAT III program, and GMLRS development through LRIP is an ACAT II program. Both are included in the MLRS Upgrade, an ACAT IC program.

An Acquisition Program Baseline (APB) was approved in March 1998 that restructured the MLRS rocket programs. Under this plan, there was to be no Milestone III full-rate production decision in the ER program. LRIP of the ER rocket was to continue until FY00, and GMLRS was expected to be cut into production starting in FY02. Approximately 4,000 of the ER rockets were fielded to provide an interim capability to U.S. Forces, Korea. These rockets were fielded with the M77 DPICM bomblet because of difficulties developing the self-destruct fuze.

The GMLRS program is now being restructured because of breaches in schedule and cost. The draft revised schedule shows the GMLRS full-rate production decision in mid-FY06, almost two years later than in the original APB. The LRIP decision slips about 16 months.

GMLRS is an international program with France, Germany, Italy, and the United Kingdom. GMLRS was an Advanced Technology Demonstration program (ATD) starting in 1994.

TEST & EVALUATION ACTIVITY

The principal developmental test activity in FY00 was the Design Verification Test (DVT) of nearly 20 areas of engineering design, including bearing friction and temperature, fin load, tail section stiffness, forward cover release, and rocket structure and bending. Six static firings of the rocket motor propellant were conducted. There was major activity in software development and construction of a hardware-in-the-loop facility. The program is also experimenting with different types of Center-Core-

Bursters (CCB), which expel the bomblets from the rocket. The various CCBs produce different bomblet pattern sizes, which must be evaluated for their impact on munition effectiveness.

The GMLRS program has completed its five-flight ATD program. These ATD flights were to demonstrate a guidance and control package that is capable of achieving a 4-mil accuracy with inertial-only guidance, and a 30-meter CEP with GPS-aided inertial guidance. Accuracy of the two inertial-only ATD flights was 1.8 and 12 mils, respectively. Accuracy of the two GPS-aided flights was 140 meters and 2.1 meters, respectively. The fifth ATD rocket had a catastrophic launch failure. The first flight tests of GMLRS prototypes are scheduled to begin in 1QFY02.

GMLRS IOT&E is scheduled for FY05 and will include the firing of 24 rockets against a towed artillery battery with surrogate personnel targets. The rockets will be fired in operationally realistic, multiple-rocket ripple missions as requested by DOT&E. Modeling will be used to relate observed test results to effectiveness requirements against the other targets in the MLRS requirements document. The IOT&E will also include a ground phase to demonstrate the command and control capabilities necessary for the effective employment of the overall GMLRS system.

TEST & EVALUATION ASSESSMENT

The GMLRS TEMP, approved by DOT&E in March 1998, has a rigorous T&E program that takes advantage of modeling and simulation to evaluate targets and conditions not tested in IOT&E. Live Fire T&E will use data from IOT&E firings against a towed artillery battery target supplemented by existing M77 data. For the first time in a fire support program, the TEMP includes targeting and command and control in a Critical Operational Issue (COI). This should highlight the importance of end-to-end system evaluation.

As noted above, the program is being restructured. A primary cause of the breach in cost and schedule has been the poor performance of the GPS-aided inertial navigation unit. The prime contractor has terminated this contract and awarded the work to the other guidance system contractor that participated in the ATD program.

Another problem the GMLRS program faces is the difficulty in obtaining a self-destruct fuze for the submunitions. The program planned to use an M235 electro-mechanical self-destruct fuze; however, problems with cost and high-rate producibility of the fuze resulted in termination of the LRIP fuze contract and an anticipated delay of two or more years. The program manager is experimenting with minor changes to the original M77 bomblet that might get the hazardous dud rate down to an acceptable level for limited U.S production. The international partners require a self-destruct fuze. The program office will explore options for an alternative self-destruct fuze and, if successful, the new bomblet will then be tested and cut in to the production line.

The TEMP is being updated to incorporate changes from the restructured program. DOT&E is encouraging the Army to include in the TEMP a plan to conduct test firings in a cold weather environment such as Ft. Greely, AK, and a plan to demonstrate interoperability with the HIMARS launcher. DOT&E is also encouraging closer coordination between the GMLRS program and the programs for the intended primary targeting sensors, such as the Q-47 Firefinder radar, whose target location error (TLE) is much larger than the expected accuracy of GMLRS.

LESSONS LEARNED

Early DOT&E involvement in the GMLRS program at the request of the User and the Program Office helped shape the development of the ORD and COICs. This will provide better linkage from T&E to the key user requirements and help ensure an end-to-end evaluation of the total system. Also, the planned use of lethality data from the IOT firings against towed artillery targets is a cost-effective means to provide Live Fire data gathered under realistic engagement conditions.

HAND EMPLACED – WIDE AREA MUNITION (WAM)

Army ACAT II Program

Total Number of Systems:	33,391
Total Program Cost (TY$):	$1,725M
Average Unit Cost (TY$):	$51.7K
Full-rate production:	FY04

Prime Contractor

Textron Defense Systems

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Wide Area Munition (WAM) is a smart, autonomous, top-attack, anti-tank munition designed to defeat armored combat vehicles from a stand-off distance. It utilizes acoustic and seismic sensors in its ground platform to detect, track, and classify potential targets, and then launches an infrared detecting submunition or "sublet" over the top of the selected tracked target. Once the sublet detects the target, it fires an Explosively Formed Penetrator (EFP) to defeat the target. Target vehicles include tanks (e.g., T-72 and T-80), breachers (e.g., KMT-4/5), and lightly armored tracked vehicles (e.g., BMP-2). The variant currently in production is the Hand Emplaced WAM (HE-WAM), also referred to as the Hornet. It is designed to be carried and emplaced by one person, have a stand-off lethal radius of 100 meters 360 degrees around, and be fully autonomous from final arming to target engagement. The WAM, when fielded, will contribute to ***precision engagement*** for the Army in the ***Joint Vision 2020*** scenario.

HE-WAM is the first fielded member of the WAM family of munitions. The WAM program did not qualify for operational test oversight from this office due to its funding threshold, but it did meet the lower funding threshold for LFT&E oversight.

BACKGROUND INFORMATION

The WAM Required Operational Capability approved in March 1990 envisioned a "Family of WAM" concept of three variants: (1) hand-emplaced; (2) Volcano-delivered; and (3) deep attack Army Tactical Missile System delivered. Although the Family of WAM has since been designated an Acquisition Category II program, only the HE-WAM version has been developed. HE-WAM was approved for LRIP in September 1996; however, full-rate production was delayed indefinitely. The Directors' Live Fire Evaluation report was submitted to Congress in July 1999. The combination of test activities was adequate to support an assessment of the lethality of HE-WAM against its expected targets and draw some inferences regarding the weapons' effectiveness.

The Army decided not to enter full-rate production of HE-WAM. Instead, the program has been restructured to include a Product Improvement Program (PIP) called the Advanced Hornet. The Advanced Hornet is expected to include two types of improvements. First, the ability of the user to communicate wirelessly with the emplaced HE-WAMs will be improved and a remote disarm capability will be added. These changes are not intended to affect lethality. However, a second area of the PIP addresses the submunition. The current HE-WAM submunition, including its sensor and warhead, will be replaced with one similar to that developed for the Air Force Sensor Fuzed Weapon (SFW) P^3I program by the HE-WAM contractor. The new warhead from the SFW P^3I program will differ substantially from the HE-WAM. In particular, HE-WAM has used a single EFP made from tantalum, whereas the SFW warhead is a multiple-fragment EFP of copper. Also, the SFW P^3I submunition uses a different sensor, which could affect the distribution of hit points on the targets of interest, which include heavy wheeled vehicles.

TEST & EVALUATION ACTIVITY

There was no LFT&E-related testing in FY00. The Live Fire IPT, however, did conclude that another lethality Live Fire program is required for the Advanced Hornet HE-WAM since the original warhead will be replaced. The Live Fire IPT, with DOT&E participation, has begun work on an LFT&E strategy. Although the strategy has not been completed, a key data source for LFT&E is expected to be a robust set of end-to-end firings against representative threat targets under varying tactical engagement conditions. If the Advanced Hornet is planned to have greater capability against heavy wheeled vehicles than the basic HE-WAM, such targets will be included in the test program. Since the SFW P^3I is also under LFT&E oversight, some of the lethality data from its LFT&E program may be applicable to the Advanced Hornet.

TEST & EVALUATION ASSESSMENT

Live Fire Testing of the current HE-WAM against actual threat vehicles demonstrated its lethality given a hit against tanks and light armored vehicles, but only when critical areas were struck. As tested, HE-WAM was not effective out to its required range, and was only marginally effective at half the required range. If the full potential of the warhead is to be achieved, improvements are needed in the accuracy of the submunition relative to the critical areas of the targets.

LESSONS LEARNED

The shotlines for the current HE-WAM warheads statically fired from a tower at a T-72 or BMP-2 were selected from a large set of potential hit points generated by an engagement model using data from ground and captive flight testing. The damage inflicted by the tower shots generally led to substantial degradation in mobility of the targets (and sometimes catastrophic loss) resulting from shotlines impacting potentially critical target areas. In contrast, the end-to-end firings of tactical HE-WAMs against moving T-72 tanks tended to hit areas at the rear and edges of the targets where there were fewer critical components, and thus, less loss of target function from impacts. This scenario illustrates the value of realistic testing, where tactical munitions attack actual operating/moving threat targets under quasi-operational conditions. Such an approach will be used for the Advanced Hornet.

INTERIM ARMORED VEHICLE (IAV)

Army ACAT ID Program

Total Number of Systems:	2,131
Total Program Cost (TY$):	$7500M
Average Unit Cost (TY$):	$2.9M
Full-rate production:	1QFY04

Prime Contractor

General Motors General Dynamics Land Systems Defense Group, LLC

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Interim Armored Vehicle (IAV) program is a family of medium armored vehicles intended to equip the Army's Interim Brigade Combat Team (IBCT). The IAV family is based on the Light Armored Vehicle (LAV) III and will consist of two basic variants, the Infantry Carrier Vehicle (ICV) and the Mobile Gun System (MGS). The ICV is, in turn, the baseline vehicle for eight additional configurations, which are based on the same platform as the ICV. These configurations are the mortar carrier, the anti-tank guided missile vehicle, the reconnaissance vehicle, the fire support vehicle, the engineer squad vehicle, the commander's vehicle, the medical evacuation vehicle, and the NBC reconnaissance vehicle.

The Key Performance Parameters (KPP) defined by the Army for all vehicles in the IAV family are: (1) the IAV must be capable of hosting and effectively integrating existing and planned Army C^4ISR systems; and (2) it must be transportable in a C-130 aircraft. The ICV and engineer squad vehicle have an additional KPP of being capable of carrying an infantry squad with its individual equipment. The

MGS has an additional KPP of being capable of defeating a standard infantry bunker and creating an opening in a re-inforced concrete wall with its main armament.

The IAV program is intended to contribute to the ***dominant maneuver*** and ***information superiority*** of the Interim Brigade Combat Team.

BACKGROUND INFORMATION

The IAV program was initiated in FY00 to provide a family of vehicles with the capabilities necessary to support the Army's IBCT. The IBCT is intended to satisfy a requirement for a combined arms team with enhanced strategic deployability. The IBCT is envisioned to be more strategically deployable than existing Army heavy forces, while having greater tactical mobility than existing light forces. While the IBCT is intended to be employable across the full spectrum of combat, the Army envisions its most likely operating environment to be small-scale contingencies in complex and urban terrain against low end to mid-range threats.

In November 2000, LAV III was selected by the Army as the IAV platform. Most of the IAV configurations are assessed by the Army to be "production-ready," based upon the fact that the base LAV III vehicle is currently in production for other countries, such as Canada. Developmental work is expected only to be necessary for the MGS, NBC reconnaissance vehicle, and FSV. All other configurations will integrate existing equipment to provide the relevant mission packages. Integration of FBCB2 digital C^2 will be accomplished by the Army at user sites after the contractor delivers the vehicles.

TEST & EVALUATION ACTIVITY

IAV T&E activities to date have focused on TEMP development to include development of an LFT&E strategy. The Director approved the initial IAV TEMP in November 2000 prior to contract award. This TEMP will be updated following contract award incorporating the details of the selected contractor's proposal and the LAV III specific configurations.

The TEMP contains provisions for a battalion-size IOT&E that will be conducted with all IAV variants and configurations not requiring significant developmental work. It is currently anticipated that all IAV variants and configurations will be available for IOT&E with the exception of the MGS, NBC reconnaissance vehicle, and the FSV. Additionally, the mortar carrier will be available with a dismounted mortar only, as a soft-recoil mortar is necessary for mounted mortar firing. The Army does not currently possess such a mortar. Additional OT events will need to be planned for those configurations not available for the first IAV IOT&E.

IOT&E will be conducted with two live IAV companies and one IAV company in simulation, provided the simulation is validated. Additionally, battalion and brigade level combat support and combat service support elements such as reconnaissance, engineer and anti-tank units will participate. This task force will operate under the command and control of a battalion tactical operations center with complete ATCCS digital C^4I systems.

The initial IAV LFT&E strategy calls for testing three MGS's, three ICV's, and one each of the ICV-based configurations. The scope of the full-up, system-level tests call for up to 120 test events spread among up to ten test vehicles.

The detailed T&E schedule, to include planned IOT&E and LFT&E dates, will be established in the forthcoming TEMP update. Initial IAV IOT&E is currently scheduled to begin in late 4QFY02.

TEST & EVALUATION ASSESSMENT

The IAV T&E program will be inherently challenging due to the need to test and evaluate ten different variants and configurations, each of which performs a different combat function. Additionally, each platform's performance will be, in large measure, dependent upon the successful integration of a variety of mission packages. Of particular interest will be the integration and performance of FBCB2 digital command and control. The organizational and operational concepts for the IAV-equipped IBCT are, to a significant degree, based upon the "information superiority" presumed to be provided by FBCB2 as well as the other ATCCS systems. Additionally the successful integration of GFE mission packages such as the M707 Striker into the FSV and the LRAS into the RV will be essential to the IAV program.

The development of the MGS will likely be the greatest program challenge. The integration of the 105 mm main gun on the LAV III chassis is, to date, largely unproven.

The Army's assumption that the majority of the selected IAV configurations and variants are "production ready" is based upon the LAV III chassis only and does not consider the total system integration of mission packages for each configuration, to include FBCB2. Much of the planned T&E effort will necessarily focus on system integration issues.

JAVELIN ANTITANK MISSILE

Army ACAT IC Program		**Prime Contractor**
Total Number of Systems		Lockheed Martin/Raytheon
CLUs:	4,510 (4,092 Army; 418 USMC)	Joint Venture
Missiles:	22,358 (19,805 Army; 2,553 USMC)	
Total Program Cost (TY$):	$3,821.2M ($765.7M RDT&E; $2,748.8M Army; $306.7M USMC)	
Average Unit Costs		
CLU (TY$):	$162K	
Missile (TY$):	$78K	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Javelin is a man-portable, fire-and-forget, medium anti-tank missile employed by dismounted troops to defeat current and future threat armored combat vehicles out to 2,500 meters. Javelin attacks most targets from the top to defeat explosive reactive armor; it also has the capability, in the direct fire mode, to attack targets under cover or those that would be unreachable by top attack. The program is in the process of replacing the Dragon system in both the Army and Marine Corps, including Reserves and National Guard. Javelin provides a medium anti-tank capability for dismounted (including light) forces while the TOW Fire and Forget and LOSAT systems will provide heavy anti-tank capabilities for all light forces.

The Javelin consists of a missile in a disposable launch tube and a re-usable Command Launch Unit (CLU), with a trigger mechanism and day/night sighting device for surveillance, target acquisition, and built-in test capabilities. The missile locks onto the target before launch using an infrared focal plane array and on-board processing, which also maintains target track and guides the missile to the target after launch. A full-up system weighs less than 50 pounds.

The Javelin Training System consists of three devices, each fulfilling a specific role. The Missile Simulation Round is a form, fit, and weight, but not functional, representation of the missile in its launch tube and is used to familiarize the gunner with the physical characteristics of the Javelin. The Basic Skills Trainer (BST) is used in classrooms to develop the basic tactical and technical gunnery skills to operate the Javelin. The Field Tactical Trainer (FTT) refines the gunner's abilities and enables the gunner to participate in both range training and force-on-force exercises. There are two FTT configurations used in the field: (1) a fixed-site version supporting instructor-guided range training; and (2) a mobile version for tactical field training and exercises.

The Javelin contributes to ***Joint Vision 2020*** as a tactical ***precision engagement*** system that enhances the Army's ***dominant maneuver*** capabilities in the ground battle. Its strong capability against threat-armored vehicles contributes to ***full dimensional protection*** for dismounted forces.

BACKGROUND INFORMATION

The January 1978 Anti-armor Mission Need Statement identified the deficiencies of the Army's current man-portable anti-armor weapon—the Dragon. The Joint Service Operational Requirements Document for the Javelin was approved in 1986 and amended in 1988 to allow for a higher weight. The Initial Operational Test & Evaluation (IOT&E), which was completed in December 1993, concluded that Javelin was operationally effective, but required further assessment for operational suitability. LRIP was approved by the DAB in July 1994. Follow-on operational testing, in the form of a Limited User Test (LUT) primarily aimed at operational suitability issues, was executed in April-June 1996 at Ft. Hunter Liggett, CA. The results of this test concluded that the Javelin was operationally suitable for introduction into the field.

An Enhanced Producibility Program (EPP) design for the Javelin missile was introduced prior to the scheduled Milestone III decision. At DOT&E's insistence, EPP missiles were tested during a Confirmatory Test in April 1997 at Ft. Benning, GA, in time to influence the Milestone III decision and reduce the scope of follow-on testing. DOT&E's B-LRIP report to Congress of May 1997 concluded that the Javelin EPP system design was operationally effective, suitable, and lethal.

Live Fire Test and Evaluation for the Javelin system was completed in October 1996. It consisted of three progressive phases that challenged the Javelin against current and emerging tank threats. DOT&E's Live Fire Lethality evaluation report was likewise forwarded to Congress supporting the Javelin Milestone III Full-rate Production (FRP) decision.

Subsequent to the FRP decision, several changes had been incorporated in the system to enhance producibility and reduce cost. The LRIP version of the CLU that was originally fielded is now being replaced with the lower cost and more maintainable FRP version. As of the end of FY00, only LRIP versions, including the EPP version, of the Javelin missile have been fielded. FRP I missiles have successfully completed lot acceptance testing.

Several reliability and availability performance thresholds for the Javelin CLU, missile, and training devices were defined relative to "System Maturity," which had been planned to occur at Milestone III plus three years (May 2000). The actual date for assessing missile maturity is under consideration for delay to May 2001 to ensure reliability problems have been resolved. Testing and analysis of data, primarily developmental in nature, to address all of the System Maturity requirements have been completed.

Failures observed during lot acceptance testing in FY99 caused the Army to reject the first lot of 500 FRP missiles because of a marginal design of the Warhead Initiation Module (WIM) provided by a new vendor. This failure mode, as well as three other subsequently discovered failure modes related to electrical shorting in the control actuation system, flight motor ignition failure, and precursor warhead failure to fire, were exhaustively investigated. Design and manufacturing process fixes were initiated throughout FY00.

The Javelin Enhanced Tandem Integration (JETI) modification, scheduled to be cut into production in the third Full-rate Production year (FRP III), modifies the manner in which the existing precursor and main charge warheads are mounted within the missile (although the warheads themselves are unchanged from earlier production). Because JETI changes are not anticipated to significantly affect Javelin's lethality, DOT&E agreed that full-up, system-level LFT&E was not warranted for near-term testing. If in the future the Army decided to replace the existing main charge warhead, full-up system-level testing would be required. The proposed Lethality Improvement Tracker Enhancement (LITE) is a tracker modification involving software changes to enhance lethality; software issues exist which have not been resolved. A recent move by industry caused several software experts to leave the program. Modified software will be less difficult to cut into production once solutions are developed. However, under the present set of circumstances, it is difficult to say when LITE production will begin.

Flight-testing against Active Protection Systems (enhancements to threat armor vehicles designed to detect and destroy incoming missiles) is underway and has been successful to date.

TEST & EVALUATION ACTIVITY

Javelin testing in FY00 consisted of the PM's continuing technical and lot acceptance testing of missiles and other system components, the missile test-fix-test program associated with the transition from LRIP to FRP, and the completion of the final phase of JETI testing.

Testing to confirm the PM's fixes to the FRP I missile design consisted of flight tests, developmental in nature, conducted at Redstone Arsenal, AL, in May-June 2000. DOT&E provided oversight by insisting that fixes be verified by flight testing vice analysis, recommending that missiles be subjected to temperature and vibrational profiles prior to firing, and seeking to extend testing beyond the first phase in which 9 of 10 missiles performed reliably. The Javelin PM fired an additional 20 missiles from the production line to demonstrate corrective action effectiveness. All of these missiles hit their targets and, as independently confirmed by DOT&E in detailed reviews of high-speed videotapes, evidenced proper timing in warhead events (i.e., precursor firing followed by a main warhead firing). These successful test results supported the Congressionally mandated certification by the Secretary of Defense that all manufacturing and technical issues had been resolved.

A subsequent failure in the warhead initiation circuit in a system qualification test of a design change for the FRP III missile (another new configuration beyond FRP I, that had been tested for Certification to Congress) is a concern. This test was of the design and integration of the new Common Electronic Safe, Arm, and Fire (CESAF) circuit.

The final phase of JETI testing will include three firings of tactical missiles against operational tank targets, conducted as part of the FRP III qualification test program.

TEST & EVALUATION ASSESSMENT

The Javelin system has been adequately tested in accordance with the OSD-approved TEMP, and declared operationally effective, operationally suitable, and lethal. The unresolved operational suitability issues concerned only the following specific reliability and availability parameters prescribed for System Maturity (Milestone III plus 3 years): training device reliability, CLU reliability and availability, and missile round reliability. Analyses of the most recent data indicate that the training devices and CLU meet or exceed their system maturity requirements with confidence.

The missile design continues to evolve in accordance with Acquisition Reform initiatives aimed at minimizing production costs. The 0.97 missile reliability (29 of 30 successful firings) observed during Certification flight testing demonstrated that the technical and manufacturing problems previously associated with the FRP I missile design have been resolved. New failure modes may surface as the missile design continues to be modified in favor of cost reduction efforts (e.g., as in the new ESAF for FRP III).

The planned JETI warhead testing is expected to be conducted in January 2001. The program is experiencing some producibility problems with the CESAF, which will be installed only in the FRP III missile. Until these component-level problems are resolved, the program does not plan to fire FRP III missiles with the JETI modification. It is anticipated that the firings will demonstrate that the JETI variant is as lethal as the existing warhead with more consistent penetration performance.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

Continued observation and analysis of Javelin missile reliability are warranted. DOT&E concern stems from the difficulties the Army has had qualifying new components in the transition from LRIP to FRP. DOT&E will continue to monitor missile reliability closely. Formal judgment will be reached at missile maturity in May 2001. If it were found after assessment at missile maturity that Javelin meets its requirements, further system maturity follow-on tests and evaluations for reliability will not be required.

Acquisition Reform encourages contractors to reduce cost while holding performance and reliability constant. ***Any post-MS III changes made must be carefully scrutinized and thoroughly tested to verify performance and reliability.*** When the Javelin prime contractor changed the source for WIM, the new WIM had been successful in different environments. However during system testing, prior to lot acceptance, the new WIM revealed a new failure mode as discussed above.

The Javelin program offers a good example of a well-executed lethality product improvement. The Javelin Program Office developed a simple, but effective, means to increase Javelin's lethality without undue risk or significant cost increase. Then, the Program Office conducted a comparative test-based assessment of the simpler alternative with a contractor-developed alternative warhead to determine the preferable option. Finally, the selected alternative underwent an IPT-developed T&E program to assess the performance of the improved Javelin warhead.

JOINT COMPUTER-AIDED ACQUISITION AND LOGISTICS SUPPORT (JCALS) SYSTEM

Army ACAT IAM Program

Total Number of Systems:	1
Total Program Cost (TY$):	$450M
Average Unit Cost (TY$):	$450M
Full-rate production:	4QFY01

Prime Contractor
Computer Sciences Corporation (CSC)

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Joint Computer-aided Acquisition and Logistics Support (JCALS) system is a multi-Service, geographically distributed client-server digital system. It is designed to process all data and information required to manage, control, and produce each Service's technical manuals at designated processing sites. The Defense Information Systems Network provides wide area network connectivity. Fiberoptic Distributed Data Interface Ethernet provides local area network connectivity among workstation servers, workstations, peripherals, collocated legacy systems, and to the wide area network.

The JCALS program is developing the infrastructure to logistically support weapons systems throughout their life cycles. The JCALS system will satisfy the Services' and Defense Logistics Agency's needs for integrated digital technical information. JCALS is using an incremental fielding strategy. Each functional user site has one or more JCALS client-server nodes based on the site's processing requirements and organization dispersal. All JCALS data are stored in the Integrated Weapon System Data base—a logically centralized, physically distributed relational data base.

JCALS supports the ***Joint Vision 2020*** operational concept of ***focused logistics*** by enabling Services and Agencies to work more effectively in managing, acquiring, updating, publishing, stocking, and distributing technical manuals in support of their customers' needs. JCALS also supports the ***Joint Vision 2020*** mandate of ***interoperability***, especially in terms of communications and information sharing. ***Information superiority*** will be realized when the Service and Agency users have the necessary information capabilities to achieve their operational objectives.

BACKGROUND INFORMATION

An initiative to develop a paperless technical and logistics information system for weapons systems began in 1986 with the Army Computer Aided Logistics Support (CALS) program. Because of the burden from excessive paper processing encountered during M-1 tank development, the Army decided to automate the process. In 1991, the CALS program expanded to all of the Services and was renamed the Joint CALS program.

In January and February 1998, testers from Army OPTEC conducted an Initial Operational Test of JCALS hardware and the first JCALS software increment, Software Package #2 (SWP2), in compliance with the TEMP approved by DOT&E in May 1997. The focus of the test was to examine technical manual activities at the Service test sites and management/administrative capabilities at the System Operational Support Center.

DOT&E's evaluation of SWP2 Initial Operational Testing revealed a variety of problems. Three effectiveness shortcomings—the lack of report generation capabilities, label printing capabilities, and indexing and numbering capabilities—affected all four Services. Additionally, two suitability deficiencies—security and system administration—affected all four Services. Two additional effectiveness issues related to Air Force-unique applications—account management of technical manuals and the interface to the legacy system—were also identified as problematic. Finally, Y2K compliance had not been demonstrated.

In April 1998, the JCALS PMO reviewed the test results and developed corrective actions. The program implemented fixes for the effectiveness and suitability issues common to all Services. Based on follow-on assessments, DOT&E concluded JCALS was operationally effective and suitable for the Army, Navy, and Marine Corps. An Acquisition Decision Memorandum (ADM) issued in August 1998 granted fielding of SWP2 to Army, Navy, and Marine Corps sites; directed the JCALS program office to correct deficiencies identified for the Air Force; and directed the JCALS program office to ensure Y2K compliance.

Follow-on evaluation of the JCALS "modified SWP2" began in November 1998 to verify corrections for the two outstanding Air Force effectiveness issues and to demonstrate Y2K compliance. Y2K certification was completed in March 1999 for the JCALS applications.

TEST & EVALUATION ACTIVITY

The "modified SWP2" product continued to undergo rigorous regression testing in the lab and follow-on evaluation in the operational environments through November 1999. At the end of the follow-on evaluation, the Army Test and Evaluation Command found the "modified SWP2" application operationally effective, suitable, and survivable for the Air Force. In December 1999, an ADM was issued to authorize operational deployment of JCALS SWP2 to Air Force sites.

The next OT event for JCALS is the test of SWP3 increment A (SWP3.A), the first block of SWP3, which is scheduled to be completed in 4QFY01. SWP3.A, with increased focus on CM and CCB responsibilities, contains transition and cutover requirements for the Army, Navy, and Marine Corps as defined in the user-approved Joint Minimum Essential Requirements List. Developmental testing is ongoing and is expected to be completed in 3QFY01. Emerging results indicate the SWP3.A product is making significant progress in meeting technical requirements.

Since June 2000, the JCALS program management office has continued to refine its acquisition strategy for SWP3. During OTRR 1a in December 2000, the JCALS PMO finalized plans to develop, test, and field SWP3 in two blocks. The core JCALS technical manual functionality will be provided upon completion of SWP3.B, the second block of SWP3. SWP3.B OT is planned for 2QFY02.

TEST & EVALUATION ASSESSMENT

JCALS continues to show improvements in its utility. As end users and system administrators gain experience with the system, they will be better able to use JCALS to manage, acquire, update, publish, stock, and distribute technical manuals for their customers. This is particularly true for Air Force users and system administrators. Of all the Services, Air Force users experienced the most changes to their business practices in transitioning to the JCALS product.

Significant improvements have been made in the training programs for system administrators. Training took place throughout October and November 2000, and post-training is ongoing by the JCALS PMO. The JCALS PMO is monitoring the performance of the system administrators and reporting training deficiencies to allow even further improvements in the training program.

CONCLUSIONS AND LESSONS LEARNED

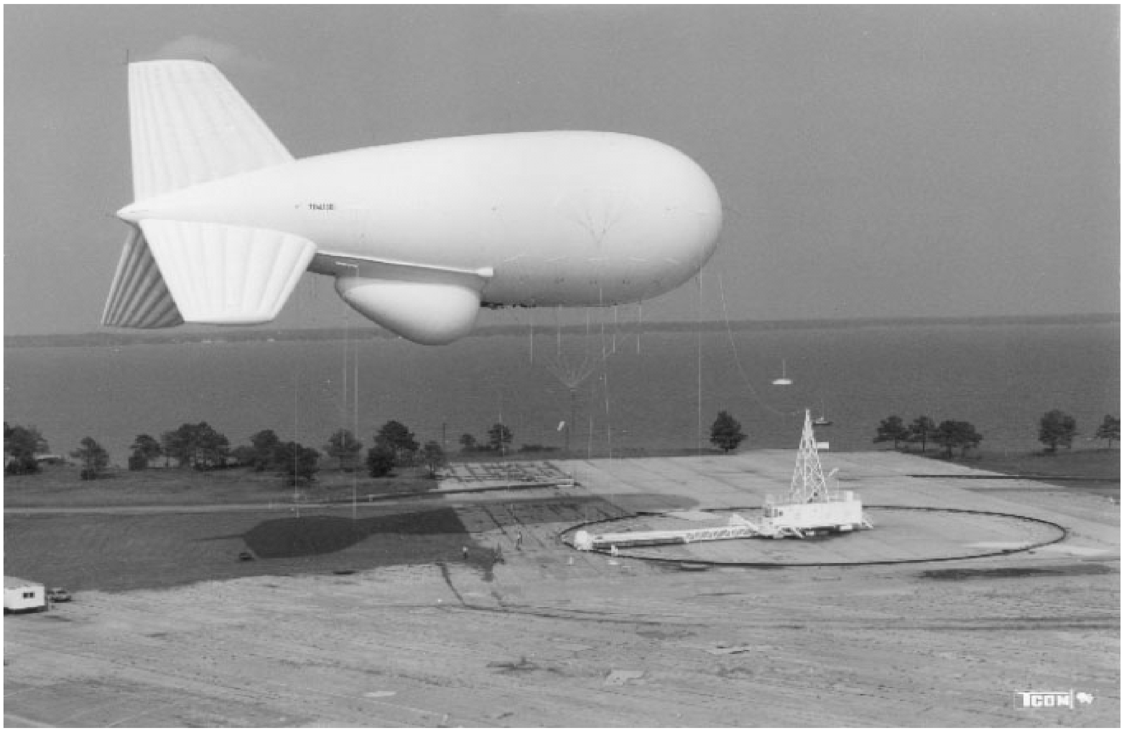
DOT&E's oversight and its interest in a thorough, robust DT program have served JCALS well. In addition, DOT&E representatives have maintained a constant presence with the JCALS program by visiting test sites, observing tests in progress, and interviewing users and system administrators providing information to better progress the program's development.

Based on DOT&E's consistent involvement with the JCALS program, DOT&E has provided measurable contributions in helping to shape the JCALS test process. DOT&E has introduced guidance for increasingly robust software development testing, in-plant software qualification testing, and site acceptance testing and operational testing. DOT&E's recommendations regarding training and documentation have brought about significant improvements in the JCALS training program.

DOT&E has encouraged the JCALS program office to make a concerted effort to learn from the experiences of earlier tests. The new program manager, appointed in 1QFY00, has pledged to work closely with the test community and bring to test a mature SWP3 product that will meet the needs of the JCALS community. DOT&E will continue working closely with the JCALS program office to facilitate this effort.

In 1QFY01, JCALS received additional congressional interest. A series of OSD-level meetings were held to review the JCALS funding profile. Results of those meetings indicate that JCALS is solvent in terms of SWP2 sustainment and SWP3 development. An OIPT is expected to convene shortly to further review the JCALS program.

JOINT LAND ATTACK CRUISE MISSILE DEFENSE (JLACMD) ELEVATED NETTED SENSOR SYSTEM (JLENS)



Army ACAT II Program		**Prime Contractor**
Total Number of Systems:	12	Raytheon
Total Program Cost (TY$):	$3.8B	
Total Production Cost (TY$):	$2.1B	
Average Unit Cost (TY$):	$175M	
Full-rate production:	Block 1: FY09	
	Block 2: FY11	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Joint Land Attack Cruise Missile Defense (JLACMD) Elevated Netted Sensor System (JLENS) will enhance surveillance capability and provide air defenders with improved ability to observe, assess, and support engagements over the entire air battlespace, enabling ***precision engagement*** through ***information superiority*** to the ***dominant maneuver*** force as they engage the enemy. The ***full-dimensional protection*** pillar of ***Joint Vision 2020*** addresses the need to protect U.S. forces from this very technology, which the U.S. is attempting to exploit. JLENS provides a critical link against the number-one priority of the full-dimensional protection pillar: ***countering air and missile threats***.

BACKGROUND INFORMATION

JLENS is an airborne radar platform designed to provide surveillance and targeting quality radar data on Land Attack Cruise Missiles (LACM) and other air breathing targets. The system also acquires and tracks surface moving targets and supports detection and trajectory prediction of tactical ballistic missiles. A JLENS system consists of two aerostats, one containing Surveillance Radar (SuR) and one containing a Precision Target Illumination Radar (PTIR). The aerostats are non-developmental 71-meter, unmanned, tethered, non-rigid aerodynamic structures filled with helium and air. Each aerostat is tethered to a mobile mooring station and attached to a processing station through a fiber-optic powered tether. The SuR provides the initial target detection, cueing the PTIR, which generates an engagement quality track. The JLENS system is integrated into the Joint Tactical Architecture via TADIL-J, CEC, SINCGARS, and EPLRS capability. The system provides key contributions to generation of a Single Integrated Air Picture through the fusion of high accuracy long-range tracking and target classification information with that of other sensors in the Joint Theater Air and Missile Defense architecture. Both radar systems will include Identification Friend or Foe interrogators.

Shooters such as PATRIOT, Navy Standard Missile, the Marine Corps Complementary Low Altitude Weapons System (CLAWS), and the Army HUMRAAM [HUMVEE mounted Advanced Medium Range Air-to-Air Missile (AMRAAM)] can use the JLENS PTIR data to engage low-flying terrain masked LACMs before their own ground-based sensors can detect them. JLENS supports Air-Directed Surface-to-Air-Missile (ADSAM) and Air-Directed Air-to-Air Missile (ADAAM) engagements through both the engage on remote and forward pass mechanisms.

The JLENS program is being executed in two blocks. Block 1 develops the PTIR fire control radar, which has a sector search capability. Block 2 develops the full azimuth 360° SuR and demonstrates its ability to hand off targets to the PTIR for engagement execution. A complete JLENS system consists of one Block 1 PTIR and one Block 2 SuR. The purchase of 12 JLENS systems consists of the purchase of 12 PTIR, 12 SuR, 24 Mobile Mooring Systems, and 24 processing systems.

TEST & EVALUATION ACTIVITY

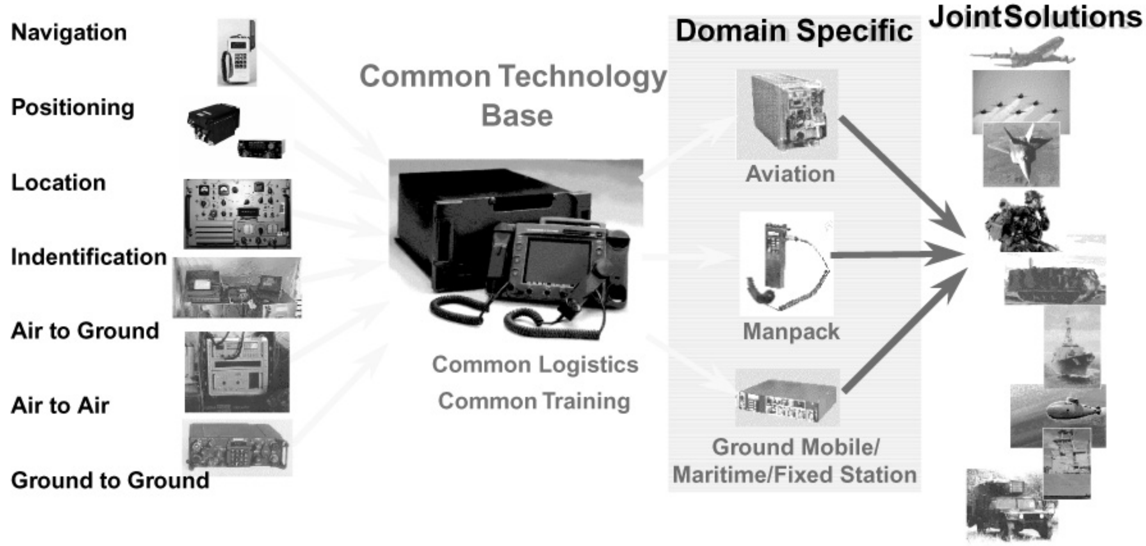
A prototype system consisting of surrogate radars was used to demonstrate potential military utility of air directed SAMs. The prototype system demonstrated a forward pass capability, acquiring the target and guiding an AMRAAM launched from a CLAWS and HUMRAAM, to shoot down a BQM-74 drone in a Joint Theater Air and Missile Defense Organization sponsored experiment. In these demonstrations, the HUMRAAM launched its missile, based on JLENS data, against a target that the HUMRAAM could not see because of terrain masking. The HUMRAAM then passed control of the AMRRAM to the JLENS radar, which could detect the target. The JLENS surrogate successfully guided the missile to the target.

The Army is currently writing a JLENS TEMP. The operational testing of JLENS will be structured to ensure that it can support Army, Navy, and Air Force LACM defenses and kill chains, including Medium Extended Air Defense System (MEADS), PATRIOT, AMRAAM, and Standard Missile.

TEST & EVALUATION ASSESSMENT

N/A

JOINT TACTICAL RADIO SYSTEM (JTRS)



Pre-MDAP Program (Army Lead)

Total Number of Systems:	TBD
Total Program Cost (TY$):	TBD
Full-rate production:	Army: FY06 Navy: TBD Air Force: TBD

Prime Contractors

Modular Software Radio Consortium
(Raytheon, ITT, Marconi, Rockwell-Collins,)

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2010 AND 2020

The Joint Tactical Radio System (JTRS) is a family of affordable, high-capacity, programmable, multi-band/multi-mode tactical radios designed to provide both line-of-sight and beyond-line-of-sight communication capabilities to the warfighters. JTRS uses software-defined radio technology to achieve the needed flexibility, upgradeability, and interoperability. JTRS is a pre-Major Defense Acquisition Program that currently has no fieldable radios. The program is in the process of refining an open Software Communications Architecture (SCA) using prototype laboratory radios of the Modular Software Radio Consortium.

Information superiority underpins the operational concepts outlined in ***Joint Vision 2010*** and ***Joint Vision 2020***. JTRS responds to the need for ***information superiority*** by providing seamless, high-speed communications for voice, data, and video exchange within the joint battlespace. JTRS is an enabler for ***conducting joint operations*** with ***full spectrum dominance***.

BACKGROUND INFORMATION

The Quadrennial Defense Review in 1997 identified the need and benefits of combining various Service radio acquisition programs incorporating programmable software technology. The office of the ASD (C^3I) conducted a Programmable Modular Communications System IPT from February-August

1997, to identify an architecture baseline and guidance document for the Department's future tactical radios. The Joint Requirements Oversight Council (JROC) and the Joint Staff (J-6) review of numerous radio programs identified the need for a consolidated program office. The JROC approved the JTRS Operational Requirements Document on March 23, 1998. Per direction of the Defense Planning Guidance, the ASD (C^3I) forwarded a Joint Tactical Radio Plan that approved the Management Execution Plan forwarded by the Army Acquisition Executive. In April 1998, USD (A&T) requested that each Service Acquisition Executive aggressively pursue the necessary steps to achieve the goal of minimizing new programs and migrating existing development programs for software-based radio communication systems to a single acquisition program. The JTRS Joint Program Office (JPO) was established to coordinate the program. The importance of the JTRS effort was emphasized in an August 1998 ASD (C^3I) memorandum directing that all Service efforts to independently develop and acquire any radio system be held in abeyance.

The JTRS program's approach is to define an open architecture for the Services to acquire software-based radios. The purpose of the architecture is to ensure acquisition efficiency across the Department, foster the use of commercial-off-the-shelf products, and promote interoperability. The JTRS program is being implemented in three steps. Step 1, completed in May 1999, defined the architecture through the SCA Specification. Step 2, to be completed in November 2000, further refines the SCA and develops prototype systems for validating the architecture. In Step 3, the validated SCA will be made available to the Services to develop and procure SCA compliant radios to satisfy Service requirements.

The JTRS JPO, in conjunction with the Service radio acquisitions, will acquire waveform software that can be ported to the SCA-compliant radios during their development. Depending on service requirements, the Services will procure SCA-compliant radios in clusters. An acquisition cluster is defined as a group of radios meeting similar requirements in a given timeframe. The original concept of grouping similar requirements into "domains" (i.e., fixed/seaborne, airborne, ground vehicular, manpack, and handheld domains) still exists, but it was determined this year that from an acquisition perspective not all of a domain's requirements could be satisfied economically near-term with a technology that is evolving. In recognizing this, the Joint Staff group that developed the JTRS Operational Requirements Document is revising the document to group the requirements into time-phased blocks (in addition to domains) to support either a pre-programmed product improvement or an evolutionary acquisition approach to address the requirements. The JTRS program is still defining the definitions and determining how to divide responsibility for development within the clusters.

TEST & EVALUATION ACTIVITY

The primary test and evaluation activity has been the definition of test and evaluation programs for the overall JTRS and the JTRS Army efforts via the IPT process. Test and Evaluation Master Plans for the overall JTRS and the Army's JTRS program are being written and coordinated using this process.

JTRS SCA validation testing began in August 2000.

TEST & EVALUATION ASSESSMENT

To date, the fundamental issue complicating the definition of the test and evaluation program for the JTRS program has been the lack of a definitive JTRS program structure due to evolution of the program throughout the year. The current concept is to have a joint capstone program to do waveform development and mange the SCA, and to have individual Service-lead programs to acquire SCA-compliant radios in clusters. A capstone JTRS Test and Evaluation Master Plan addressing JPO efforts (architectural compliance, new waveform testing, and joint interoperability) has been drafted. Annexes for each specific JTRS cluster will be planned as needed. In the JTRS-Army program, which is the first cluster acquisition, program objectives are being refined and key acquisition decisions are being identified.

An appropriate test and evaluation strategy will require continued efforts to resolve fundamental concerns such as cluster definition, developing joint concept of operations, and precisely defining information exchange and interoperability requirements. Areas of particular interest for any test program include backward compatibility with existing radios, joint interoperability, and logistics supportability of hardware and software. Other issues requiring resolution are designating a joint combat developer to define Critical Operational Issues and a concept of operations, structuring the Operational Requirements Document to support an evolutionary acquisition approach, incorporating affordability as a Key Performance Parameter, and designating lead test agencies for testing JPO products and Service cluster radios.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

Early tester involvement can enhance the integration of testing into the program and contribute to program success. Further, early involvement fosters the interpersonal communications needed among testers, material developers, and combat developers to develop the understanding necessary to design meaningful tests. However, while early involvement by the test community can identify acquisition strategy uncertainties and issues, it cannot resolve them.

KIOWA WARRIOR

Army ACAT II Program

Total Number of Systems:	385
Total Program Cost (TY$):	$3.26B
Average Unit Cost (TY$):	$8.1M
Full-rate production:	
KIOWA:	1QFY86
KIOWA WARRIOR:	3QFY89

Prime Contractor

Bell Helicopter Textron, Inc. (airframe)
Boeing Electronics Systems (MMS)
Honeywell, Inc. (CDS and software)
Rolls Royce-Allison (engine)

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The OH-58D KIOWA WARRIOR is a two-place single engine armed reconnaissance helicopter. The KIOWA WARRIOR is an armed version of the earlier OH-58D KIOWA Advanced Helicopter Improvement Program aircraft, which itself was a highly modified version of the OH-58A KIOWA. The principal difference between the KIOWA WARRIOR and its immediate OH-58D predecessor is a universal weapons pylon on both sides of the aircraft, capable of accepting combinations of the semi-active laser Hellfire missile, the Air-to-Air Stinger missile, 2.75" Folding Fin Aerial Rocket pods, and a 0.50 caliber machine gun. In addition to these weapons, the KIOWA WARRIOR upgrade includes changes designed to provide improvements in air-to-air and air-to-ground communications, mission planning and management, available power, survivability, night flying, and reductions in crew workload through the use of on-board automation and cockpit integration.

The primary mission of the KIOWA WARRIOR is armed reconnaissance in air cavalry troops and light attack companies. In addition, the KIOWA WARRIOR may be called upon to participate in Joint Air Attack operations, air combat, limited attack operations, or artillery target designation.

The KIOWA WARRIOR leverages ***information superiority*** and ***precision engagement*** capabilities to enhance the Army's ***dominant maneuver*** in battle.

BACKGROUND INFORMATION

The KIOWA WARRIOR is a Category II acquisition program. The Army has acquired 411 KIOWA WARRIORs through either modification or retrofit of existing OH-58 KIOWAs. The KIOWA WARRIOR replaces AH-1 attack helicopters currently found in air cavalry troops and light attack companies and OH-58 A/C KIOWAs in air cavalry troops.

The basis for the latest KIOWA WARRIOR OA (1994) was the Dual Station Unit Fielding and Training Program (DSUFTP) conducted by the Combat Aviation Training Brigade (CATB) at Ft. Hood in 1993. The planning and execution of the KIOWA WARRIOR DSUFTP, which consisted of both live fire and non-live fire force-on-force exercises, was coordinated between the CATB, the U.S. Army OPTEC, and DOT&E to ensure that the program provided the opportunities needed to support an adequate OPEVAL. This was an innovative use of combined testing and training carefully coordinated to accomplish both testing and training objectives.

Using data from the DSUFTP, DOT&E concluded that the addition of the weapons, improved cockpit integration, and better navigational capability resulted in an aircraft that is much more effective than previous OH-58 models. Furthermore, the potential enhancements to mission planning and management provided by the aviation mission planning system and data transfer system were very apparent during DSUFTP. Moreover, these improvements were achieved without any noticeable impact on readiness as measured by the aircraft's demonstrated operational availability. However, several areas of concern were observed. Among the most critical were the impact of weight growth on the aircraft's power margin, endurance and auto-rotation performance, and the impact of several important Interim Statements of Aircraft Qualification restrictions on the operational utility of the KIOWA WARRIOR.

To address these and other concerns, a Safety Enhancement Program for the OH-58D KIOWA WARRIOR was initiated to incorporate an improved engine with full authority digital electronic control, crashworthy crew seats, air bags, improved master controller processor, and data modem. The Safety Enhancement Program is expected to improve engine reliability and crew crash protection, reduce pilot workload during emergency maneuvers, and provide additional digitization capabilities. However, it should be noted that the Safety Enhancement Program does not solve the safe auto-rotation problem. As currently planned, the Safety Enhancement Program will involve the modification of 301 aircraft, which began in FY98.

DOT&E approved the KIOWA WARRIOR LFT&E strategy in July 1996. An updated LFT&E strategy, approved in January 1999, identified the resources (hardware, tests, and schedule) necessary to carry out the program. The approved LFT&E strategy outlines a two-phase ballistic program to investigate the vulnerability of the main rotor blade, Mast Mount Sight (MMS) support and ball, and the Lazy Susan bearing supporting the MMS. The two phases are intended to address ballistic damage tolerance under static (loaded and unloaded components) and dynamic (fully rotating rotor system) conditions. The KIOWA WARRIOR Live Fire Testing began in FY99.

TEST & EVALUATION ACTIVITY

At the direction of the T&E IPT, the KIOWA WARRIOR Program has revised the TEMP to describe test plans on future and ongoing product improvements. OSD approval of an updated TEMP is anticipated in 1QFY01.

DOT&E monitored the progress of Safety Enhancement Program testing. Installation of Federal Aviation Administration-certified crashworthy seats—similar to those used in TH-67 training aircraft—began in FY00. Cockpit airbags were tested in UH-60s in FY99 and in KIOWA WARRIORs in June 2000. Emerging results are favorable. Installation of airbags will begin once the Army has approved a requested material release.

The Army is developing limited digital capability for the OH-58D to participate in Phase I of the Army's Division Capstone Exercise (DCX) scheduled to be conducted at the National Training Center from March-April 2001. The Force XXI Battle Command Brigade and Below (FBCB2) Limited Users Test 3 will be conducted concurrently. The test plan for the control and display system software and hardware (CDS4) to support digital communications for KIOWA WARRIOR during DCX stipulates a comprehensive battery of developmental flight testing to support air worthiness evaluation and safety release. CDS4 functionality, Improved Data Modem functionality, Joint Variable Message Formats send/receive capability, and interoperability with the Advanced Field Artillery Tactical Data system and Aviation Mission Planning System are planned for test. Testing is currently in progress at Yuma Proving Ground and at Ft. Hood.

KIOWA WARRIOR Live Fire Testing began in FY99 with the execution of ten ballistic firings against sections of the main rotor blade. No funds were allocated in FY00 for the LFT&E program, so no tests were conducted this past year. The Army has the funds and the necessary authority to continue execution of the Live Fire Tests in FY01, and is currently working with DOT&E to develop a revised schedule of the remaining tests. Component-level testing of the main rotor blade and mast mounted sight will resume this year and may continue into FY02. The final series of Live Fire tests will be conducted against an operating KIOWA WARRIOR helicopter in FY02-03. Preparation of the helicopter for these tests is now scheduled to begin in FY02.

TEST & EVALUATION ASSESSMENT

The OH-58D program is beyond the production and fielding phases. The last OH-58D production aircraft was delivered in October 1999. The Army is pursuing several sustainment initiatives to include the Safety Enhancement Program, digitization, weight reduction, new HF radio, new engine barrier filter, and cockpit airbags. The level of ongoing and projected T&E of system enhancements is adequately documented in the updated TEMP. There are three critical areas that need attention before the KIOWA WARRIOR can be considered as having been adequately tested: (1) the impact of weight growth on the aircraft's ability to safely land in an emergency situation requiring an auto-rotation; (2) survivability (LFT&E Program); and (3) software upgrades.

The Safety Enhancement Program has improved engine reliability and crew crash protection, reduced pilot workload during emergency maneuvers, and provided additional digitization capabilities. The improved engines are generally performing well. Airbags have been tested and will be installed once they are certified. However, it should be noted that the Safety Enhancement Program does not solve the safe auto-rotation problem. As a result of continued gross weight issues (weight growth), coupled with limited rotor inertia, there remains insufficient kinetic energy in the rotor system to "cushion" the aircraft safely during emergencies requiring an auto-rotation. Consequently, the aircraft continues to operate on the margins of safety if the crew is presented with a situation requiring an emergency auto-rotative landing. For this reason, the Army maintains 5,200 pound gross weight limitation for aircraft operations. Under these conditions, KIOWA WARRIOR would be unsuitable for production.

Although a sufficient Live Fire test program has been identified, and testing was initiated in FY99, the program stalled in FY00 for lack of Army funding. Funding has been resumed in FY01, and the next LFT&E test firing is scheduled for December 19, 2000. The LFT&E program is projected to be complete in FY03.

The mixed performance of the other modifications continues to be addressed. Deficiencies with the improved mast mounted sight processor have largely been fixed and test results show that the sight meets its requirements. Problems that were noted in exchanging messages with the Army's Advanced Field Artillery Tactical Data System are being corrected in the context of the Army's ongoing battlefield digitization development and experimentation. Some of these corrective actions include: (1) refinements to training; and (2) tactics, techniques, and procedures. Other corrective actions involve software modifications to the aircraft's improved data modem.

LAND WARRIOR

Army ACAT II Program

Total Number of Systems:	41,000
Total Program Cost (TY$):	$2028M
Average Unit Cost (TY$):	$39K
Full-rate production:	3QFY03

Prime Contractors
Computer Sciences Corporation
Exponent Corporation

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Land Warrior is a first generation integrated fighting system for dismounted combat soldiers. It is intended to enhance the lethality, command and control, survivability, mobility, and sustainment of individual soldiers and infantry units. Its capabilities contribute to the ***Joint Vision 2020*** operational concept of ***dominant maneuver*** by dismounted forces.

The Land Warrior consists of five sub-systems:

- Computer/radio sub-system including a computer, squad radio, soldier radio, and GPS.
- Software sub-system.
- Integrated helmet assembly sub-system including a helmet-mounted display and a day/night image intensifier.

- Weapon sub-system with currently fielded M16A2 or M4 rifles, light weight thermal weapons sight, close combat optic, infrared aiming light, laser range finder, and digital compass assembly.
- Protective clothing and individual equipment sub-system including body armor, NBC protective clothing, and load bearing equipment.

Land Warrior integrates a combination of Land Warrior developed equipment, equipment that has already been fielded, and other items under development to be provided to the Land Warrior program as government furnished equipment. Land Warrior is intended to be fully interoperable with the digital command and control of other platforms.

BACKGROUND INFORMATION

Land Warrior began EMD in January 1996. An Early Operational Experiment (EOE) was conducted in October-December 1996 at Ft. Benning, GA, with ten surrogate prototypes. This EOE provided human factors information, principally with regards to the form, fit, and function of the helmet and load-bearing equipment, which supported system design reviews. Additionally, the EOE was used to aid in the development of tactics, techniques, and procedures. Land Warrior was originally scheduled to begin OT in 3QFY98. However, due to hardware problems encountered during technical testing in April 1998, the program manager halted further system development pending an overall program review and subsequent program restructuring. Land Warrior was placed on OSD T&E oversight in April 1998.

Based upon the program review conducted in FY99, key changes were implemented in the Land Warrior program. These changes included: (1) the Land Warrior program office assumed the system integration function from the prime contractor; (2) efforts to develop Land Warrior-unique load carrying equipment and body armor were eliminated and replaced with GOTS systems, specifically the joint service Modular Lightweight Load-Carrying Equipment and Interceptor Body Armor; and (3) increased reliance was placed upon COTS computer technology and software in order to minimize the development of Land Warrior-unique hardware and software.

TEST & EVALUATION ACTIVITY

No OT has occurred to date.

The major program effort for FY00 was preparing for and participating in the Joint Contingency Forces Advanced Warfighting Experiment (JCF AWE) conducted at Ft. Polk, LA, September 8-20, 2000. An infantry platoon from the 82d Airborne Division equipped with prototype Land Warrior systems participated in this event. While not designed as a T&E event, Land Warrior program efforts in support of the JCF AWE should provide valuable user feedback to the program on ways to improve the system.

The Land Warrior TEMP remains under development and has not yet been submitted to the Director for approval. The TEMP is anticipated to be submitted to DOT&E in May 2001. Government DT is scheduled to begin in 3QFY01, with an IOT&E scheduled to begin in 4QFY02.

TEST & EVALUATION ASSESSMENT

The restructured Land Warrior program has been a positive development and is based upon a more realistic assessment of the technical challenges facing the program. Early indications are that the revamped Land Warrior prototypes are more robust and much improved from the human factors perspective. An increased reliance upon COTS/GOTS sub-system technology instead of Land Warrior-unique components should decrease technical development and system integration problems and improve interoperability with other ground combat systems.

The technical areas which will require the most effort and continue to present the highest risk include: (1) overall system integration by the program; (2) batteries and power management; (3) system ruggedness and weight; and (4) software, particularly digital C^2 functionality. Of particular interest will be the achievement of Land Warrior digital interoperability with the FBCB2 system. Also of interest will be the capability of Land Warrior to provide system battery power sufficient to meet the needs of sustained ground combat.

LINE-OF-SIGHT ANTI-TANK MISSILE (LOSAT)

Army ACAT II Program

Total Number of Systems:	172 FU; 1,560 missiles
Total Program Cost (TY$):	$1,171M
Average Unit Procurement Cost (TY$):	Fire Units: $3.6M Missiles: $238K
Full-rate production	1QFY06

Prime Contractor

Lockheed Martin Missile and Fire Control, Dallas, TX

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Line-Of-Sight Anti-Tank (LOSAT) Missile is an anti-tank weapon system designed to provide lethal fire, defeating any known or projected armor systems at ranges greater than 4,000 meters. It uses kinetic energy as its kill mechanism and is the first of the Army's Kinetic Energy Missile programs. LOSAT, which will be mounted on a U.S. Army High Mobility Multi-Purpose Wheeled Vehicle (HMMWV) chassis, is being developed as a supplemental anti-armor capability for fielding in five light divisions currently equipped with TOW and Javelin anti-tank systems. The basic organizational unit for LOSAT will be a five-man squad equipped with two HMMWVs and a high-mobility trailer. One HMMWV, called the Fire Unit, will be the LOSAT missile launch vehicle that can carry four ready-to-fire missiles. The fire unit can engage two targets sequentially. The other vehicle, the Re-supply HMMWV, will tow a Missile Re-supply Trailer carrying eight additional missiles. The system is to be deployable by strategic (e.g., C-5, C-17) and tactical airlift (C-130), and external air transport via UH-60L and CH-47 helicopters. The design of the Fire Unit is heavily constrained by a

Key Performance Parameter (KPP) that requires that it be sling-loadable from a UH-60L helicopter with a threshold requirement for two ready rounds and an objective requirement four rounds. Therefore, only minimal armor protection will be provided on the Fire Unit; the Re-supply vehicle will have no armoring. The trailer will have some form of armoring, such as Kevlar blankets or a form of metal protection. The Re-supply vehicle may, however, be equipped with the Shortstop Electronic Protection System to provide a defense against some types of indirect fires.

The LOSAT fire control system is based on the Improved Bradley Acquisition System, which features an acquisition system using a second-generation, Forward-Looking Infrared (FLIR) sensor and a daylight TV. LOSAT is capable of operating autonomously or with other systems using its digitized command and control/interoperability capability. The fire control system allows the gunner/commander to acquire and auto-track up to two targets simultaneously. Once the gunner initiates launch consent, the system automatically initializes and guides the missiles to the targets in a sequential manner: the missile accelerates to 5,000 feet per second and then flies to maximum range in approximately five seconds.

The current configuration of LOSAT is significantly different from the configuration and concept originally proposed in the 1980s. While the missile has remained essentially the same, the carrier has changed from the Bradley chassis to a HMMWV. Further, the new configuration has no turret. This means that its field of engagement is now 20-30 degrees of frontal area versus 360 degrees provided in the original configuration with a turret. Finally, its mission profile has changed from that supporting a mechanized infantry force in a Warsaw Pact scenario, to a light infantry role supporting early entry missions, such as securing an airfield.

Most of the technology in the current LOSAT system is well established, except for the missile guidance. The guidance for the high velocity missile, which follows a slightly curved path after launch, is a technical challenge for the development program. The LOSAT missile guides itself to the target utilizing “missile position relative to the target” updates received via laser pulses from the LOSAT Fire Unit.

LOSAT is intended to contribute to ***Joint Vision 2020*** as a ***precision engagement*** system enhancing the Army's ***dominant maneuver*** capabilities in the ground battle.

BACKGROUND INFORMATION

The LOSAT program began as an Acquisition Category (ACAT) I Army system with OSD T&E oversight. In 1992, in order to preserve the kinetic energy missile technology, the program was designated as an Advanced Technology Demonstration (ATD). Subsequently, the Joint Requirements Oversight Council upgraded the program to an Advanced Concept Technology Demonstration (ACTD) in 4QFY97. Formal testing of LOSAT was initiated, including the Early Soldier Involvement Plan, motor testing, attitude control motor testing, spin testing, and air drop rigging/static load testing although the funding for T&E had been reduced.

Although initially LOSAT was to be mounted on an extended length Bradley Fighting Vehicle chassis, during the ATD period the Army proposed mounting LOSAT on an Armored Gun System (AGS) chassis. When the AGS program was cancelled, LOSAT was reconfigured for a HMMWV chassis. The current ACTD design efforts further involve updating the missile electronics and integrating the fire unit electronics into the HMMWV.

In late December 1999, Program Budget Decision 745, supported by the Army Chief of Staff, provided additional non-ACTD developmental funding for FY01-03 and initial procurement funding in FY04-05. To reflect this plus-up, the program is currently being restructured to enter an EMD-like phase, referred to by the Program Manager as "ACTD Plus," to prepare for an LRIP decision in early FY04, rather than FY06 as previously planned. This LRIP decision in FY04 will be followed by IOT&E in FY05. Results of this testing will support a full-rate production decision in early FY06.

On July 11, 2000, the re-structured LOSAT program was designated an ACAT II program, with Milestone Decision Authority delegated to PEO, Tactical Missiles. OSD had designated LOSAT for DT&E, OT&E and LFT&E oversight. Furthermore, LOSAT will require LFT&E for both assessments for the vulnerability of the system (Fire Unit, Re-supply Vehicle, and Re-supply Trailer) and the lethality of the missile.

TEST & EVALUATION ACTIVITY

There was little T&E activity this year involving actual hardware. The primary test activities related to the planning required to develop the overall test program to support the PEO's MS II decision expected in November 2000. As part of the LOSAT test program, Dismounted Battlespace Battle lab Demonstrations will be conducted in the FY04 timeframe to examine: (1) deployability/mobility; and (2) survivability (Force-on-Force). A Limited Users' Test (LUT) will conduct Field Training Exercises and Live Fire Exercises. This will be a full-scale operational exercise to assess the effectiveness, suitability, and survivability of the LOSAT Weapon System, and to provide decision makers information as input to the LRIP decision. IOT&E is currently scheduled to be conducted in FY05, and will involve live firings and force-on-force exercises. Since the LOSAT is to provide a supplemental capability to an existing force, IOT&E must include a baseline comparison with the currently proposed light force anti-tank capability (e.g., ITAS TOW, Javelin). LOSAT's 'value added' and other KPPs must be demonstrated in representative terrains.

A combined vulnerability and lethality LFT&E strategy has also been developed and is included in the TEMP. The data for the survivability evaluation will be derived from a multi-phased test program that culminates in a full-up, system-level test that will subject all three vehicles of the LOSAT system (Fire Unit, Re-Supply Vehicle, and Trailer) to a variety of expected threats. Rather than conducting lethality testing dedicated solely to LFT&E, specific firings during planned Production Qualification Testing (PQT), LUT, and (if required) IOT&E missile flight tests have been identified. Relatively high-fidelity threat targets will be used to provide sufficient lethality data. Also, some lethality test data from prior testing has been assessed as being applicable to the current missile design.

TEST & EVALUATION ASSESSMENT

At this stage of the program's history, only limited operational assessments based on earlier developmental tests are possible. These tests included 27 prior missile launches to evaluate missile guidance and missile-tracking performance using the 2nd generation FLIR, as well as evaluations to measure lethality effectiveness. LOSAT demonstrated that it is capable of defeating any current or projected tank it hits. Furthermore, test results had revealed that launch effects from shock, g-load, flash, toxic gases, pressure, and sound (in and outside the vehicle) fall within the Army's acceptable ranges for human factors.

LOSAT has numerous operational performance questions to be addressed in future testing, either within the ACTD-Plus test program or in subsequent formal OT&Es. Some of the many issues to be resolved include:

- What are the LOSAT tactics, techniques, and procedures for light forces, and how do they interplay with TOW F&F?
- How will the LOSAT gunner identify friend-or-foe prior to an engagement?
- Can the LOSAT gunner auto-track multiple targets and engage sequentially?
- What are the impacts of countermeasure and thermal clutter effects on target acquisition, tracking, and command link?
- What are LOSAT's limitations in representative terrain where its range advantage may be nullified by line-of-sight restrictions?
- How effective are the training simulators/programs? Although there are no current plans for firing actual LOSAT missiles in a training environment, there will be live soldier firings during LUT and IOT&E as well as during PQT firings. The system must be man-rated sufficiently early in PQT to allow for soldiers to fire LOSAT during this phase.
- How survivable is the LOSAT crew on the modern battlefield?

From an LFT&E perspective, the kinetic energy missile is expected to be lethal given that it hits its intended targets. The missile firings against high-fidelity targets will be used to verify this expectation. The survivability of the system itself is more problematic. The Army has chosen to trade-off ballistic protection of the LOSAT vehicles and trailer for enhanced deployability as part of a light early entry force. As such, to ensure that the LOSAT system remains sling-loadable from a UH-60L helicopter, the system's armor protection levels were constrained. The LFT&E program will assess the degree to which the LOSAT system, including the missile, both HMMWV vehicles, and the loaded trailer is vulnerable to the expected threats.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

The LOSAT is being developed to support the light early entry forces at the same time that the TOW Fire & Forget is being developed for a similar mission. There is a need for each system to demonstrate its contributions to the effectiveness of light forces during their intended mission. As part of this effort, their functional dependencies and interrelationships need to be demonstrated. Additionally, high fidelity training equipment must be developed and tested prior to IOT&E to ensure that an adequate level of troop proficiency can be maintained in the absence of live missiles for training. Because of the size of the safety fan required during LOSAT launches, testing in some desired test conditions (e.g., representative terrain with limited LOS) may require non-tradition range locations.

By drawing lethality data from planned end-to-end missile firings against threat combat vehicle targets, the LOSAT LFT&E program continues the successful trend of other recent Live Fire programs.

LONGBOW APACHE

Army ACAT IC Program		**Prime Contractor**
Total Number of Systems:	501	Boeing
Total Program Cost (TY$):	$8.76B	
Average Unit Cost (TY$):	$11.3M	
Full-rate production:	1QFY96	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The AH-64D Longbow Apache is a remanufactured and upgraded version of the AH-64A Apache attack helicopter. The primary modifications to the Apache are the addition of a millimeter-wave Fire Control Radar (FCR) target acquisition system, the fire-and-forget Longbow Hellfire air-to-ground missile, updated T700-GE-701C engines, and a fully integrated cockpit. In addition, the aircraft has improved survivability, communications, and navigation capabilities. Most existing capabilities of the AH-64A Apache are retained.

The AH-64D is being fielded in two configurations. The full-up AH-64D includes all of the improvements listed above. The other version of the AH-64D does not have FCR, Radar Frequency Interferometer, or the improved engines. The AH-64D without FCR is more affordable, yet remains capable of employing Longbow Hellfire missiles autonomously or in cooperation with the FCR-equipped AH-64. Five hundred and one AH-64A Apaches in the fleet are to be upgraded to the AH-64D configuration; approximately half (227) will be equipped with the FCR.

The mission of the attack helicopter is to conduct rear, close, and deep operations; deep precision strike; and armed reconnaissance and security when required in day, night, or adverse weather conditions. The AH-64D is a ***dominant maneuver*** platform that leverages ***information superiority*** and ***tactical precision engagement*** to provide ***full-dimensional protection*** for the ground maneuver force.

BACKGROUND INFORMATION

The combined Longbow Apache and Longbow Hellfire IOT&E was conducted in four phases: (1) gunnery; (2) force-on-force; (3) air transportability; and (4) aircraft conversion. The gunnery phase of IOT&E was conducted from January-February 1995, at the Naval Weapons Center, China Lake, CA. Testing conducted at Ft. Hunter Liggett, CA, during March 1995, compared the Longbow Apache armed with the Longbow and Semi-Active Laser missiles with the baseline AH-64A. Both the test and baseline attack helicopter companies conducted missions against a battalion-sized enemy ground force augmented with formidable air defenses, while a real-time casualty assessment system imposed realistic friendly and enemy losses. Air transportability and aircraft conversion demonstrations were conducted at the contractor facility.

One issue uncovered during IOT&E that required Follow-on Testing (FOT) involved a method of employment for the Longbow Hellfire missile. During IOT&E's force-on-force phase, Longbow Apache crews frequently overrode the system's automatic firing mode selection and fired missiles from a masked position using the Lock-On Before Launch Inhibit (LOBL-I) firing mode. This technique significantly increased the helicopter's survivability during IOT&E, but had not been validated with live missile firings during preceding DT/OT.

The DAB authorized full-rate production of the aircraft and radar in October 1995. The attendant ADM, dated October 18, 1995, required OSD approve the Army's plan to test the LOBL-I mode of engagement. The ADM also stated that testing would culminate with missile firings at moving targets.

The first Longbow Apache equipped battalion, the 1-227th, completed the Unit Fielding and Training Program in November 1998 at Ft. Hood, TX. The second Longbow Apache battalion, the 2-101st, achieved Initial Operational Capability in October 1999 at Ft. Campbell, KY. A third battalion is undergoing initial training and should complete fielding in November 2000.

TEST & EVALUATION ACTIVITY

OSD (DOT&E) worked with the Army to develop a plan for a FOT of the LOBL-I engagement to confirm system performance using this firing technique. The test program included digital simulations of the missile's target acquisition and fly-out, Hardware-in-the-Loop (HWIL) testing of the guidance section, Low-speed Captive Fight Test (LSCFT) of the missile seeker, and live missile firings at moving armored vehicles. The simulations, LSCFT, and four of the planned eight missile firings were completed in FY99. Missile firings suspended to address some software anomalies surfacing as a result of testing were completed in August 2000.

TEST & EVALUATION ASSESSMENT

IOT&E and LFT&E were conducted in accordance with the approved TEMP (September 1994). As reported to Congress in the October 1995 B-LRIP report and Live Fire Test report, these tests were adequate to provide the information necessary to determine the system operationally effective, suitable, and survivable. Specifically, AH-64D was found to be substantially more effective than the AH-64A in its IOT&E. During the gunnery phase, AH-64D was able to acquire and effectively engage targets in obscuration that precluded engagement by the AH-64A. During force-on-force testing, the AH-64D force was significantly more lethal and survivable than the AH-64A force.

The Longbow Apache was also found to be suitable for fielding. The system met its reliability and maintainability requirements although several objectives were not achieved. AH-64D operational availability compared favorably with the AH-64A, although the system fell short of wartime availability objectives.

The LOBL-I FOT, conducted in accordance with the OSD approved plan, was a remarkably innovative use of Modeling and Simulation (M&S) to support OT&E. In this instance, M&S was used to characterize the missile's performance in the LOBL-I mode in a far wider range of conditions than could be examined using just field testing. Factors such as target range and time delay (the time between locating the target and firing the missile) were varied based on what was observed during the IOT&E force-on-force test results. Only after the M&S results were analyzed were informative cases selected for LSCFT and live fire missile shots. The results from the LSCFT and the missile firings were then compared to the M&S predictions to help further validate the simulation models. This was a noteworthy example of field test results (from the IOT&E) supporting M&S (digital, HWIL, and LSCFT)—the results of which supported field testing (live missile shots).

The LOBL-I FOT was suspended on shot four of eight live missile shots scheduled because of software anomalies (high number of unexplained false returns on possible targets). Once the software anomalies were resolved, the conditions on shot number four were tested again to confirm the software fix. The LOBL-I FOT then continued with shots five through eight. Initial observations of the test data suggest the test met its objective of confirming accurate characterization of the missile's performance in the LOBL-I mode. A detailed analysis of the test data will confirm these results.

Taken in their entirety, data from digital and HWIL simulations, LSCFT, and missile firings quantified key factors significantly affecting the missile's probability of acquiring and hitting the target when fired in the LOBL-I mode. These factors include target range, time delay (the time between locating the target and firing the missile), target radial velocity (target speed and aspect angle), and the ability of the missile software to reject background clutter when searching for higher speed targets at longer ranges.

LONGBOW HELLFIRE

Army ACAT IC Program

Total Number of Systems:	12,905
Total Program Cost (TY$):	$2.52B
Average Unit Cost (TY$):	$163.3K
Full-rate production:	1QFY98

Prime Contractor

Lockheed Martin/Northrop Grumman

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Longbow Hellfire missile is a fire-and-forget version of the Hellfire anti-tank, air-to-ground missile. The Longbow Hellfire features an active radio frequency seeker operating in the millimeter wave frequency band and a dual tandem warhead designed to defeat reactive armor. Either the AH-64D's Fire Control Radar or a laser designator may designate targets for the missile. The Longbow Hellfire can engage both moving and stationary vehicles.

The Longbow Hellfire missile will provide an adverse weather, fire-and-forget, heavy anti-armor capability for the Army's AH-64D Longbow Apache attack helicopter. The Longbow Hellfire is a tactical ***precision engagement*** weapon that enhances the Army's ability to dominate ground maneuver battle.

BACKGROUND INFORMATION

Combined Longbow Apache and Longbow Hellfire IOT&E was conducted in 1995. The gunnery phase of IOT&E was conducted from January-February 1995, at the Naval Weapons Center, China Lake, CA. This phase of testing compared the Longbow Apache firing the Longbow and Semi-Active Laser (SAL) missiles with the baseline AH-64A firing the SAL missile in obscured and unobscured conditions. The force-on-force phase of IOT&E was conducted at Ft. Hunter Liggett, CA, during March 1995. The objectives of this phase were to assess the operational effectiveness of an attack helicopter company equipped with the Longbow weapon system (relative to one equipped with the current AH-64A) and to assess the operational suitability of the aircraft. Both the test and baseline attack helicopter companies conducted missions against a battalion-size enemy force, augmented with an appropriate slice of air defenses. A real-time casualty assessment system was used for kill removal.

One issue uncovered during IOT&E that required follow-on testing involved a method of employment for the Longbow Hellfire missile. During the IOT&E's force-on-force phase, Longbow Apache crews frequently overrode the system's automatic firing mode selection and fired missiles from a masked position using the Lock-On Before Launch Inhibit (LOBL-I) firing mode. This technique significantly increased the helicopter's survivability, but had not been validated with live missile firings during preceding DT/OT.

The DAB authorized LRIP of the Longbow Hellfire missile in October 1995. The attendant ADM, dated October 18, 1995, required that OSD approve the Army's plan to test the LOBL-I mode of engagement. The ADM also stated that testing would culminate with missile firings at moving targets.

The decision for full-rate production of the missile, delegated to the Army by OSD, was made in November 1997, with a commitment to continue to test fire using the LOBL-I engagement technique. The first unit was equipped in July 1998, and by December 1999, the Army had 1,334 missiles in inventory.

TEST & EVALUATION ACTIVITY

OSD (DOT&E) worked with the Army to develop a plan for a Follow-On Test (FOT) of the LOBL-I engagement to confirm system performance using this firing technique. The test program included digital simulations of the missile's target acquisition and fly-out, Hardware-in-the-Loop (HWIL) testing of the guidance section, Low-speed Captive Flight Test (LSCFT) of the missile seeker, and live missile firings at moving armored vehicles. The simulations, LSCFT, and four of the planned eight missile firings were completed in FY99. The missile firings that were suspended to address some software anomalies that surfaced as a result of testing were completed in August 2000.

TEST & EVALUATION ASSESSMENT

IOT&E and LFT&E were conducted in accordance with the approved TEMP (September 1994). As reported to Congress in the October 1995 B-LRIP report, these tests were adequate to provide information necessary to determine the entire Longbow Apache Weapons System operationally effective, suitable, and survivable. Specifically, the AH-64D armed with the Longbow Hellfire was found to be substantially more effective, under the conditions evaluated, than the AH-64A Apache armed with the SAL Hellfire. During the gunnery phase, the AH-64D was able to acquire and effectively engage targets in obscuration that precluded engagement by the AH-64A. During force-on-force testing, the AH-64D force was significantly more lethal and survivable than the AH-64A force.

The LOBL-I FOT was an innovative use of Modeling and Simulation (M&S) in support of OT&E. In this instance, M&S was used to characterize the missile's performance in the LOBL-I mode in a far wider range of conditions than could be examined during field testing. Factors such as target range, aspect angle, and time delay (the time between locating the target and firing the missile) were varied based on what was observed during IOT&E's force-on-force test results. Only after the M&S results were analyzed were informative cases selected for LSCFT and live fire missile shots. The results from LSCFT and the missile firings were then compared to the M&S predictions to validate the simulation models. Further, this was a noteworthy example of field test results (from the IOT&E) supporting M&S (digital, HWIL, and LSCFT), the results of which support field testing (live missile shots).

Four shots of the scheduled eight-shot FOT were completed in November 1998. During these missile firings, software anomalies in the missile seeker were detected, leading to the suspension of the remaining missile firings. Since then, funding interruptions have delayed software development and affected the test schedule. Consequently, LSCFT of the missile seeker with the revised software and the remaining missile firings—which were to be completed during FY99—were not completed until August 2000.

Despite the delays, the data from the digital and HWIL simulations, LSCFT, and missile firings conducted to date have identified factors that significantly affect the missile's probability of acquiring and hitting the target when fired in the LOBL-I mode. These factors include target range, time delay (the time between locating the target and firing the missile), and target radial velocity (target speed and aspect angle). These emerging results do not alter DOT&E's assessment that the Longbow Apache and Longbow Hellfire Missile are operationally effective, suitable, and survivable. However, the final FOT results are expected to influence future AH-64D tactics, techniques, and procedures, reflecting the lessons learned during this phase of testing.

LESSONS LEARNED

As explained above, Longbow Apache crews frequently used the LOBL-I method of engagement during the IOT&E force-on-force phase to fire missiles from a masked position and thereby reduce their susceptibility to engagement by threat air defense systems. The crews' clear preference for this mode was not discovered until the aircrews encountered a sufficiently realistic air defense threat environment during IOT&E.

The Army's (PM Longbow Hellfire and Apache) approach to subsequent LOBL-I testing, to investigate the impact of that mode on the missiles probability of hit, was a good example of using M&S to support OT&E. Importantly, however, the program illustrates the criticality of confirming M&S results with field testing. The software anomalies that led to the suspension of live missile shots would not have been detected or the subsequent revision of the missile seeker software implemented otherwise.

M829E3 120-MM APFSDS-T CARTRIDGE

Army ACAT II Program

Total Number of Systems:	65,000
Total Program Cost (TY$):	$481.6M
Average Unit Cost (TY$):	$5K
Full-rate production:	FY03

Prime Contractor

Alliant Techsystems

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The M829E3 Armor-Piercing Fin-Stabilized Discarding Sabot-Tracer (APFSDS-T) cartridge is one of the 120mm main gun rounds designed for the Abrams tank. It is a Kinetic Energy (KE) round that fires a depleted uranium rod designed to penetrate and destroy enemy heavy armored vehicles. The focus of M829E3 development is on propulsion improvements. The design is driven by the need to counter KE-effective Explosive Reactive Armor (ERA) and the desire to destroy targets at longer range than is possible with the current M829A2.

The improved tank round will support the ***dominant maneuver*** force aspect of ***Joint Vision 2020*** by enhancing the lethality of the Abrams main battle tank.

Due to the funding threshold, the M829E3 program does not require operational test oversight from this office. However, the Army nominated this program for LFT&E oversight based on projected program cost.

BACKGROUND INFORMATION

DOT&E/LFT involvement in this program includes both lethality and vulnerability test and evaluation. System lethality will be assessed with respect to expected threat tanks. The Abrams tank will be assessed to ensure that there is no increase in system vulnerability when carrying the M829E3 as compared to the current ammunition (M829A2). In 1QFY00, DOT&E approved the LFT&E Strategy, which included combined lethality and vulnerability test requirements. The strategy includes the agreement that data from developmental testing and production qualification testing against range targets and shotline simulant targets will be leveraged as much as possible for lethality evaluation. Data for the vulnerability evaluation will rely on simulated and full-scale ammunition compartment tests.

An Engineering and Manufacturing Development (EMD) contract was awarded in 4QFY98. EMD developmental testing began in FY99 and continued through FY00.

TEST & EVALUATION ACTIVITY

EMD test activity primarily consisted of component level testing of the penetrator and the propulsion system. The test data supported various design trade-offs and material comparisons. If any of this data is relevant to the final production configuration, it will be used to support the EMD lethality analysis.

TEST & EVALUATION ASSESSMENT

The lethality portion of the approved LFT&E Strategy includes a plan for more than 100 shots with M829E3 penetrators to establish a baseline for comparison with more than 300 shots with M829A2 penetrators. These shots will be fired against a combination of semi-infinite Rolled Homogeneous Armor (RHA) with and without ERA, finite RHA, and various range targets with and without ERA. The different types of armor will test the depth of penetration the round is capable of.

Production Qualification Test (PQT) will consist of a two-phase series of shots against range targets. Phase I includes 67 firings of the production-representative M829E3 against range targets with and without ERA, and Phase II includes 36 shots against targets designed to represent specific shotlines through threat vehicles with and without ERA. Specific data will be gathered on the behind armor debris performance of the new design versus the in-service M829A2.

Vulnerability testing will include five tests against simulated ammunition compartments and three tests against full-scale ammunition compartments tests with actual Abrams turret and hull ammo stowage.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

The provision for use of shotline simulant targets in Phase II PQT represents an intelligent approach to realistic lethality testing, given the difficulties inherent in acquiring representative threat targets and testing with ERA and depleted uranium ammunition.

MANEUVER CONTROL SYSTEM (MCS)

Army ACAT ID Program

Total Number of Systems:	3,156	
Total Program Cost (TY$):	$1,030M	
Average Unit Cost (TY$):	$188K	
Full-rate production:	3QFY02	

Prime Contractor
Block IV–Lockheed Martin

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Maneuver Control System (MCS) is the central command and control system for the maneuver elements in battalion through corps echelons. MCS consists of a network of computer workstations that integrate information from subordinate maneuver units with those from other Army Tactical Command and Control System battlefield functional areas to create a joint common data base referred to as the Common Picture. Tactical information products, such as situation maps and reports, allow the display and manipulation of this information. MCS also provides a means to create, coordinate, and disseminate operational plans and orders. MCS' role in communicating battle plans, orders, and enemy and friendly situation reports make it a key component of the Army's ongoing effort to digitize the battlefield. As the primary command and control system from battalion to corps, MCS facilitates ***dominant maneuver, precision engagement, focused logistics,*** and ***full-dimensional protection***.

BACKGROUND INFORMATION

In 1980, the Army fielded the first MCS system with limited command, control, and communications capabilities to VII Corps in Europe. In 1982, the Army awarded a five-year contract to continue MCS development, and by 1986 MCS software had evolved to Version 9, also fielded in Europe. In 1987, the Army performed post-deployment tests on Version 9 in Germany. These tests led the Army Materiel System Analysis Activity to conclude that MCS did not exhibit adequate readiness for field use and that further fielding should not occur until the problems were resolved. However, the Army awarded a second five-year contract that resulted in Version 10, which was fielded in October 1988.

In 1988, the Army awarded a contract for the development of Block III software Version 11. By 1993, the Army stopped development of software Version 11 because of program slips, design flaws, and concerns with cost growth. The program was reorganized in April 1993, forming a team of contractors and government software experts to develop software Version 12.01 using software segments salvaged from Version 11.

In September 1996, the Army awarded a contract to initiate development of the next version of MCS. This effort, the Block IV MCS, is being developed by Lockheed Martin and involves substantially different software, including the required Defense Information Infrastructure Common Operating Environment. The Army postponed IOT&E of Block III in November 1996 due to software deficiencies. In lieu of IOT&E, a Limited User Test was conducted from October-November 1996 to establish a Block III baseline and identify software problems requiring correction prior to IOT&E. This operational assessment, completed in May 1997, supported the Army's procurement of MCS for the training base prior to successful completion of IOT&E.

The Army conducted MCS Block III IOT&E in June 1998 during a Division Command Post Exercise at Ft. Hood, TX. This test included live Tactical Operations Centers (TOCs) at division, brigade, and battalion echelons equipped with 47 MCS workstations. This testing was adequate to confirm that the MCS program had achieved significant improvements in functionality since the last operational test event, as well as demonstrated the potential to provide enhanced military capability in the future digital battlefield. However, there were significant test and system limitations present, and MCS performance was marginal for several critical measures.

The most critical limitation was the lack of realistic movement and dispersion for the TOCs. A number of experimental systems installed in the TOCs of the 4th Infantry Division, which served as the test unit, were inadequately integrated or hardened for field employment—particularly for the rigors of tactical displacement. Consequently, the TOCs did not: (1) deploy to field locations; (2) disperse tactically, or (3) displace in accordance with anticipated mission profiles. In 3QFY99, when the DOT&E assessment concluded that MCS Block III was not effective or suitable, the Army decided to restructure the MCS program with Milestone III following Block IV IOT&E.

During restructuring of the Army's Battlefield Digitization Architecture, it was decided that Force XXI Battle Command, Brigade and Below (FBCB2) hardware would not be present in TOCs: situation awareness information will be processed by FBCB2 Embedded Battle Command software and command and control functions (messages, orders, overlays, etc.) will be performed by Army Battle Command Systems (ABCS) software, both hosted on ATCCS workstations. Therefore, any testing that includes units above the company level must include both ATCCS and FBCB2 systems as well as requisite interoperability between FBCB2 and ABCS software.

TEST & EVALUATION ACTIVITY

The MCS Program was scheduled to deliver Block IV Version 6.0 software for Battlefield Digitization developmental testing in November 1999, which was to be followed by operational testing of FBCB2 and MCS (along with the other ABCS systems) in April 2000. Both of these test events were downgraded as a result of immature ABCS/MCS software, and the MCS T&E Strategy and TEMP were in revision to identify replacement events throughout the remainder of the fiscal year. To date, the MCS TEMP has not been submitted for either Army or OSD review.

The proposed T&E strategy for future MCS testing includes a series of system-of-system events that will examine the performance of two hardware variants (workstations and laptops), and involve elements of the 4th Infantry Division, the 1st Cavalry Division, and III Corps. The 1st Cavalry Division role is critical because they will not possess FBCB2 at the time of testing, and it must be confirmed that MCS works well with both automated (FBCB2) and manual inputs. The final event, MCS IOT&E, will be tailored to meet remaining data requirements based on the results of all prior test events.

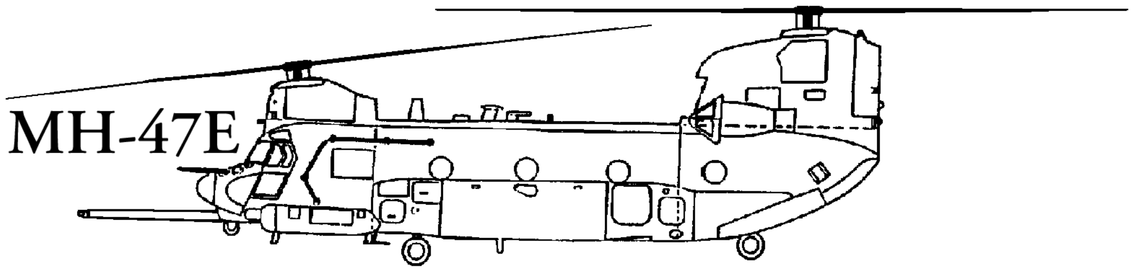
TEST & EVALUATION ASSESSMENT

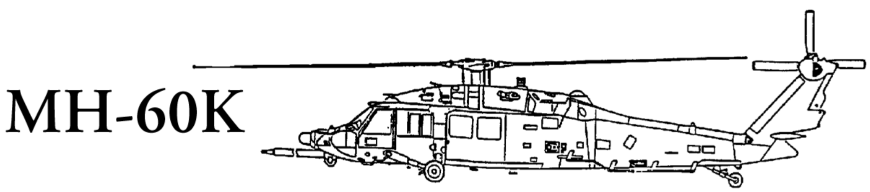
As tested during IOT&E in June 1998, MCS Block III is not operationally effective or suitable. Although many of the Block III functions performed as designed, the evaluation identified shortfalls in the areas of data base accuracy, interoperability, logistics supportability and user acceptance, especially at lower echelons (battalion) employed with greater operational realism. Additionally, employing MCS with the realistic tactical dispersion and displacement of a dynamic battlefield is expected to further degrade operational performance.

The Army is still involved with the integration of the many software components comprising MCS Block IV. Many program managers, including some who do not report to the Army's Program Executive Officer for Command, Control, and Communication Systems, are developing these components. The complexity of the integration and configuration management of diverse software development efforts is significant, and the challenge in preparing MCS 6.0/6.1 for FY00 testing is evidence of this. Data from this testing indicate that MCS software lacks critical functionality, possesses many cumbersome workarounds, and is not sufficiently stable for the operational environment. These shortfalls caused the postponement of the FBCB2 LUT 2 in April 2000. Critical areas where ABCS/MCS failed to meet the FBCB2 LUT 2 entrance criteria included TOC server stability, transmission of situation awareness messages across brigades, development and distribution of overlays and operational orders, and management and display of the common tactical picture. Delays in the delivery of Version 6.2 functionality needed for the Army's April 2001 Division Capstone Exercise are anticipated based on the problems experienced—and that remain—with the foundational products contained in MCS 6.0 and 6.1.

Future testing of MCS must be conducted in the ABCS system-of-systems environment with division-level TOC dispersion and displacements to demonstrate the ability of MCS to maintain the common tactical picture for the maneuver force on a dynamic battlefield. The importance of movement for Tactical Operations Centers cannot be overstated, particularly with the growing emphasis that our potential adversaries are placing on disruption and destruction of our command and control capabilities, and the reliance on mobility to enhance survivability in the Army's transformation to lighter forces. The resulting vulnerabilities against such threats must also be completely assessed.

MH-47E SPECIAL OPERATIONS AIRCRAFT AND MH-60K SPECIAL OPERATIONS AIRCRAFT (SOA)





Army ACAT IC Program

Total Number of Systems:	
MH-47E:	26
MH-60K:	23
Total Program Cost (TY$):	
MH-47E:	$690M
MH-60K:	$633M
Average Unit Cost (TY$):	
MH-47E:	$26.55M
MH-60K:	$27.52M
Full-rate production:	
MH-47E:	3QFY91
MH-60K:	3QFY91

Prime Contractor

MH-47E: Boeing Helicopter
MH-60K: Sikorsky Aircraft

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The MH-47E Special Operations Aircraft (SOA) is a derivative of the Boeing CH-47 Chinook. Along with other modifications, it has a significantly increased fuel capacity with modified main and auxiliary fuel tanks. To enable long-range missions without refueling, the main fuel tank is enlarged to hold 2,068 gallons, while three auxiliary tanks, which hold 800 gallons each, are also available. The MH-60K is a derivative of the Sikorsky UH-60 Blackhawk. Its modifications include a significantly increased fuel capacity with two 185-gallon internal fuel tanks, side-by-side, against the rear bulkhead. In addition, in-flight refueling probes have been added. Both aircraft have modified integrated avionics suites and multi-mode radar, and are intended to provide adverse-weather infiltration/exfiltration and support to U.S. military forces, other agencies, and special activities. These U.S. Special Operations Command (USSOCOM) aircraft contribute to the ***Joint Vision 2020*** concept of ***dominant maneuver*** by helping to create asymmetric advantages for combined application of land, air, and sea power against enemy defenses within the Joint environment. They are capable (as modernized multi-mission platforms operating within tailor-to-task organizations) of supporting precise, agile, fast-moving joint operations.

Due to their funding thresholds (less than the Major Defense Acquisition Program), the MH-47E and MH-60K SOA programs were not required to undergo operational test oversight from this office. However, these systems do qualify for LFT&E oversight since they qualify as major systems.

BACKGROUND INFORMATION

These aircraft were treated as one program and were placed on the LFT&E oversight list in October 1991. Since the program was past Milestone III before the funding level breached what was needed for LFT&E oversight, the National Defense Authorization Act for Fiscal Year 1993 made provisions to complete LFT&E prior to the Full Materiel Release Decision. The Acquisition Executive for USSOCOM has granted this system a waiver from full-up, system-level live fire testing. Letters notifying Congress of this waiver, along with the required accompanying LFT&E Alternative Plans (approved by DOT&E in July 1997), were submitted by the USSOCOM Acquisition Executive to USD (A&T) on December 22, 1997. The DOT&E LFT&E Report on the results of this testing is near completion and will be forwarded to the congressional defense committees in FY01.

TEST & EVALUATION ACTIVITY

Under the approved alternative LFT&E plan, testing focused on the major changes made to the aircraft since the basic versions of these aircraft have experienced combat and combat damage already. In the case of the MH-47E, change occurred via the addition of up to three 800-gallon Robertson Auxiliary Fuel Tanks in the cabin and Boeing-designed sponson tanks with an expanded capacity of 2,068 gallons, and a composite honeycomb shell construction. For the MH-60K, testing addressed the two additional 185-gallon Robertson Auxiliary Fuel Tanks in the cabin.

Analyses conducted during the test planning phase revealed two potential vulnerabilities. The *first* potential vulnerability was associated with projectiles entering the fuel tanks in the volume above the liquid fuel level known as the ullage. Such impacts could ignite the fuel vapors and cause widespread explosions and/or fires. During LFT&E test planning, USSOCOM decided to add an inerting system to the fuel tanks to avoid such fires/explosions. This inerting system will undergo development and flight testing in 1/2QFY01, and will begin installation in CY01. The MH-47E will be a lead-the-fleet system available for similar helicopter variants in other fleets. A *second* potential vulnerability was associated with projectiles impacting the fuel tanks below the fluid level and causing loss of fuel and or fires. To address this possibility, a series of Live Fire tests were completed at Aberdeen Proving Ground in August-September 1997, firing a variety of expected threats. In approving the alternative plan, DOT&E requested that additional tests be conducted with larger caliber threats if the test articles remained viable after the planned series of shots. These additional tests were completed in March 1998.

TEST & EVALUATION ASSESSMENT

The MH-47E fuel tanks and the MH-60K auxiliary fuel tanks demonstrated exceptional ability to withstand ballistic impacts of projectiles associated with small arms, automatic weapons, and anti-aircraft artillery. The tanks are designed to be self-sealing against 12.7-mm projectiles. However, the live fire tests indicated that the tanks designs are effective against much larger non-exploding projectiles, even with multiple impacts on the same tank. The designs also proved to be effective in mitigating the fuel loss from impacts by high-explosive incendiary projectiles. In addition, there were no fires in the 23 shots except for one, which self extinguished before any significant damage was done. One of the reasons for the strength of this design against ballistic threats is the fact that the tanks are designed to be crashworthy, which adds to its robustness against the ballistic threat as well.

LFT on these systems was completed in May 1998, and the Army's data reports were delivered to OSD in June 1998. DOT&E's independent LFT&E Report is in draft form awaiting the Army's final evaluation report, which is expected to be delivered in early FY01. DOT&E's independent evaluation report will be delivered to Congress within the required 45 days from DOT&E's receipt of the Army's evaluation.

RECOMMENDATIONS, CONCLUSIONS AND LESSONS LEARNED

The self-sealing fuel tanks of the MH-47E and the MH-60K performed better than expected. The Army is examining the potential use of these designs on other aircraft such as the CH-47D upgrade.

A valuable lesson learned from this LFT&E program is that early analysis of an aircraft can have a direct impact on the design. In the case of the Special Operations Aircraft, fuel tank ullage explosion was identified as a potential vulnerability based on analysis and past testing of other aircraft. The analysis was sufficient to cause Special Operations Command to pursue fuel tank inerting without the cost of additional testing.

The fuel tank inerting is also an example of where a design feature incorporated to reduce ballistic vulnerability can have a positive effect on system safety in peacetime and war. Inerting the fuel tanks can also reduce the hazards of fire and explosion in normal operations such as lightning.

MULTIPLE LAUNCH ROCKET SYSTEM (MLRS) M270A1 LAUNCHER

Army ACAT IC Program

Total Number of Systems:	857
Total Program Cost (TY$):	$2,280.2M
Average Unit Cost (TY$):	$2.418M
Full-rate production:	1QFY02

Prime Contractor

Lockheed Martin Vought Systems

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Multiple Launch Rocket System (MLRS) provides a non-nuclear, all-weather, indirect, area fire weapon system to strike high-payoff threat maneuver, fire support, forward area air defense, and command and control, and communications (C^3) targets at all depths of the tactical battlefield. MLRS consists of a self-loading launcher with an onboard fire control system. The MLRS M270 Launcher is the standard U.S. Army platform for firing surface-to-surface artillery rockets and missiles. The launcher is mounted on a mobile track vehicle that carries 12 rockets in two, six-rocket Launch Pod Containers (LPC) or two Army Tactical Missile System (Army TACMS) missiles, which can be fired individually or sequentially. Rockets have a range beyond 30 kilometers, and the Army TACMS Block IA missile can reach beyond 300 kilometers. M270A1 improvements are intended to enhance the field artillery's support to the ***dominant maneuver*** force, and improve ***precision engagement*** capabilities for shaping the battlespace at extended ranges.

The M270A1 program includes two major upgrades to the current M270 launcher. First is the Improved Fire Control System (IFCS), which replaces obsolete, maintenance-intensive hardware and software, providing growth potential for future munitions and the potential for reduced launcher operation and support costs. IFCS includes a GPS-aided navigation system. Second, the Improved Launcher Mechanical System (ILMS) improves reaction times and increases ***full-dimension protection*** by decreasing the time to aim, fire, and reload the launcher. A faster launcher drive system that moves simultaneously in azimuth and elevation reduces the traverse time from the stowed position to worst case aimpoint by approximately 80 percent, and decreases the mechanical system contribution to reload time by about 40 percent. Additionally, the M270A1 program includes the re-manufacture of selected components and the application of selected Engineering Change Proposals to the basic M270 launcher to bring all launchers to the same configuration.

BACKGROUND INFORMATION

MLRS initial operational capability occurred in 1983. To combat the growing obsolescence, the Army initiated the IFCS program in 4QFY92. In 4QFY95, the Army began the ILMS program to address a requirement for faster prosecution of highly mobile, short-dwell targets. In FY96, the Army combined the IFCS and ILMS test programs under the M270A1 to undergo system-level testing even though both remained as separate ACAT III program elements through system integration. On May 28, 1998, the Program Executive Officer for Tactical Missiles approved low rate initial production (LRIP) of IFCS and ILMS hardware modification kits for integration into the M270A1. In 4QFY98, the program decided to replace the 486-based executive processor with a PowerPC processor, and the proprietary software operating system with the commercial VxWorks software operating system.

From January-April 1999, the launcher executed an Extended System Integration Test (ESIT) that included a position navigation unit test, field exercises, and a flight phase that was terminated because of system problems. In July 1999, IOT&E slipped 22 months to allow the program time to fix problems identified in the ESIT and Maintainability Demonstration, and to include the planned replacement of the executive processors and operating system. In August 1999, the program conducted a Customer Test for one platoon of M270A1 launchers side-by-side with a platoon of M270 launchers.

TEST & EVALUATION ACTIVITY

A 2QFY00 Confidence Demonstration demonstrated fixes to 102 “go-to-war” Software Trouble Reports (STR) and successful conversion to the PowerPC and VxWorks. From June-October 2000, the contractor conducted system integration testing with an Engineering Release of updated software. The M270A1 successfully fired rockets on August 1, 2000, and an Army TACMS Block IA missile on September 14, 2000. Government flight tests and a second ESIT (with soldiers) are scheduled in early 2001.

The Army conducted an MLRS survivability program to complete survivability estimates of the M270A1, determine the effects of M270A1 improvements on the survivability of the fielded launcher, and develop recommended changes to the M270A1 and MLRS tactics to enhance launcher and crew survivability. The Aberdeen Test Center completed blast and shock tests in 1997 and payload sensitivity tests in 4QFY98. The Army Research Laboratory, Survivability/Lethality Analysis Directorate completed component experiments in 1998 and a vulnerability analysis in 1999.

In March 2000, DOT&E approved a revised M270A1 TEMP. The IOT&E ground phase is now scheduled for August 2001, followed by the OT flight phase in September. Milestone III will occur in

2QFY02. However, as of December 2000, the Army Test and Evaluation Command had not funded the required $4.2 million for the IOT&E that is to occur in 4QFY01.

TEST & EVALUATION ASSESSMENT

IFCS software problems have been a continuing challenge. The IFCS development contract was extended nine months through September 1998 to improve software robustness and maturity. Lack of software maturity in the 1999 ESIT caused crews to re-boot the system and re-configure communications frequently, and resulted in low mission transmission and fire mission completion rates. M270A1 crews in the Customer Test had to employ an extensive list of workarounds for software problems, but M270A1 times from stowed position to first round fired were from 35 to 80 percent better than the basic M270 launcher times. The Confidence Demonstration showed that communications, system and mass storage device lockups, and prompt delay problems have been corrected. The June Engineering Release corrected an additional 49 suitability and maintainability STRs. However, launcher problems in updating missile software and stowing the Launcher Loader Module (LLM) during the latest flight test in September 2000, along with two safety problems identified during the Preliminary System Integration Tests, have caused an additional six month schedule slip. The safety problems involve an uncommanded LLM movement and undamped oscillations around the commanded azimuth.

Inadequate BIT/BITE performance in the FY99 Maintenance Demonstration showed a capability of detecting and isolating a problem to the line replaceable unit level of only 60-70 percent against a requirement for 95 percent. Fourth quarter fiscal year 2000 trials are close to meeting the requirement, and the launcher, tools, and Interactive Electronic Technical Manuals should be ready for the Maintenance Demonstration in March 2001.

A number of system vulnerabilities were found in the survivability program. Some can be corrected with minor engineering changes to such components as the fuel filter bracket and radiator cover to reduce the vulnerability of the system to "cheap" automotive kills. Others, however, are more significant, and their correction will entail additional armor protection to lessen the likelihood of payload initiation. The PMO provided funding to the Army Research Laboratory (ARL) to investigate possible ways to improve the armor protection of the MLRS Launcher Loader Module to inhibit a possible payload reaction from enemy fire. ARL is conducting a model-based analysis of three viable engineering solutions to improve payload protection. When the analysis is completed, the results will be provided to the PM for consideration and appropriate action.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

Even though the IFCS software development was primarily conversion of existing logic from JOVIAL to Ada, the program experienced serious integration, robustness, and maturity problems. All software development programs, no matter how trivial they may seem, require intensive oversight and management.

Problems observed, and resulting M270A1 configuration changes during the 1999 ESIT flight tests, showed that the operational test (flight and ground phases) should be conducted after hardware and software configurations have been frozen. As a result, the U.S. Army Operational Test Command has developed a Software Configuration Control Plan for the M270A1 IOT&E, and the M270A1 platoon will use LRIP launchers.

After the PM has reviewed ARL's feasible designs to improve payload protection, the best candidate should be selected and applied to all MLRS launchers. At the same time, the Army should correct some potential chassis-related vulnerabilities that were discovered during LFT&E of the Command and Control Vehicle, which uses a modified MLRS chassis.

Operation Desert Storm first identified a critical need for faster prosecution of highly mobile, short-dwell-time targets by MLRS launchers. Emerging North Korean tactics have further highlighted the importance of reducing M270 reaction times in order to engage threat mobile rocket launchers while they are exposed outside Hardened Artillery Sites (HARTS). Although problems in the Customer Test showed that further development was warranted, launcher fire mission performance indicated that the M270A1 would significantly reduce MLRS reaction times, improving the Army's ability to engage short-dwell targets.

Finally, unless the Army funds this IOT&E, DOT&E will be unable to assess the system in 2001. As a result, M270A1 full-rate production will be delayed until completion of the system's IOT&E and DOT&E's assessment to Congress that the system is effective, suitable, and survivable.

NUCLEAR, BIOLOGICAL, AND CHEMICAL RECONNAISSANCE SYSTEM (NBCRS) BLOCK II

Army ACAT III Program		**Prime Contractor**
Total Number of Systems:	33 (thru FY05)	TBD
Total Program Cost (TY$):	$113M	
Average Unit Cost (TY$):	$2.3M	
New Material Release:	1QFY05	
First Unit Equipped:	2QFY05	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Nuclear, Biological, and Chemical Reconnaissance System (NBCRS) is intended to detect, identify, mark, collect samples, and report chemical and radiological contamination on the battlefield. The NBCRS crew accomplishes these functions by using a sophisticated suite of nuclear and chemical alarms and detectors integrated within the vehicle chassis. The Block I version of this vehicle (the M93A1 Fox), which is currently being fielded, has an on-board M21 Remote Sensing Chemical Agent Alarm. The M21 allows the crew in a stationary vehicle to detect remote chemical agent clouds. The crew can perform chemical and radiological reconnaissance operations while operating in a shirtsleeve environment inside the NBCRS vehicle, even while the vehicle is operating in a contaminated area.

Block II will provide capabilities beyond that of the Block I variant. The Block II vehicle will incorporate the latest technology in nuclear, biological, and chemical agent detectors, as well as the capability of being far more fully integrated into the digitized battlefield.

Block II will be equipped with the Chemical Biological Mass Spectrometer (CBMS) Block II, which will provide an enhanced chemical detection system as well as a capability to detect and identify biological agents. The Block II version will also replace the M21 with the Joint Services Lightweight Stand-off Chemical Agent Detector (JSLSCAD), which will provide the vehicle with on the move, 5-kilometer stand-off chemical agent vapor detection capability.

Additional Block II improvements include a meteorological on-the-move capability and the latest navigational and mapping technologies. Block II is also planned to incorporate remote detection capability through the use of unmanned aerial vehicles and unmanned ground vehicles, as well as enhanced real-time feedback through satellite communications.

NBCRS is intended to be one of the Infantry Carrier Vehicle variants of the IAV, which will improve the survivability and mobility of Army ground forces by providing increased situational awareness and ***information superiority*** to supported headquarters and combat maneuver elements. With the ability to provide rapid and accurate chemical and radiological contamination information to these elements, the NBCRS vehicle forms a key portion of ***full-dimensional protection***.

BACKGROUND INFORMATION

Based on the perceived need to quickly field a chemical reconnaissance vehicle to U.S. forces in Europe in the late 1980s, the NBCRS Non-Developmental Item program was structured into three acquisition phases. The first phase, Interim System Production, provided 48 urgently needed German-produced vehicles (designated the M93) that met many of the American requirements. As part of this phase, the German government donated an additional 60 Americanized German M93 vehicles to the U.S. government in support of Operation Desert Storm.

The second phase, the System Improvement Phase, designed a vehicle (designated the XM93E1) that satisfied all American operational requirements. This vehicle underwent IOT&E from March-May 1994 at Ft. Bliss, TX. The Director determined that, combined with chemical warfare agent test results from Dugway Proving Ground, UT, the test was adequate, but the vehicle was neither operationally effective nor operationally suitable. That assessment was based on the system demonstrating chemical warfare agent detection capabilities well below the requirement, the need for excessive maintenance, and low reliability. Crew performance indicated inadequate training and/or overly complex tasks.

After integrating significant human factor improvements into the XM93E1, the Army type-classified the vehicle in June 1995 as the M93A1. The Director approved the NBCRS TEMP in December 1996. This TEMP included plans for an operationally focused Limited User Test (LUT) to be conducted as a part of the vehicle's Production Verification Testing.

The third phase of the program, the Block I modification phase, upgraded many of the M93 vehicles to the M93A1 configuration. The Test and Experimentation Command conducted the LUT in May 1998 at Yuma Proving Ground, AZ. It consisted of two M93A1 Block I configured NBCRS vehicles, each completing two 96-hour scenarios at wartime operational tempo. The vehicles performed both route and zone/area reconnaissance operations. The Director determined that this test provided enough information to assess the system as operationally effective, operationally suitable, and survivable.

TEST & EVALUATION ACTIVITY

During FY00, no testing was conducted on the Block II NBCRS vehicle itself. However, testing was conducted on various components that will be integrated into the Block II vehicle. The JSLSCAD and the CBMS Block II, which are being developed under separate programs, are currently undergoing engineering development testing.

Once the JSLSCAD, CBMS, and other sensors have been individually developed, they will be integrated into the NBCRS Block II.

TEST & EVALUATION ASSESSMENT

DOT&E is monitoring the integration of the various components into the overall vehicle system. Once this integration process is completed, DOT&E will review for approval both the TEMP and test plans for the operational testing of the Block II.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

The NBCRS Block I LUT demonstrated the need for the system vehicles under test to operate as part of a functioning tactical unit, including the presence of good unit leadership. Several times during the test, vehicle operators reported chemical reconnaissance results that, upon reflection, were either clearly inaccurate or insufficient to meet supported units requirements. A functioning unit command and control element would have provided the crews a more realistic environment for real-time feedback on the sufficiency of their performance.

It is important that it be determined before a test whether the test unit will use school-approved doctrine or the unit's own Standard Operating Procedures (SOP). During the NBCRS Block I LUT, the unit's SOP conflicted with school-approved doctrine. Since the test was constructed based on the school doctrine, the unit's non-compliance with this doctrine affected test conduct and assessment. Due to the short length of the test and the absence of NBCRS unit leadership at the test site, the test director had little time or influence to modify unit operating procedures. Test results had to be assessed with consideration for the different operating guidance.

OBJECTIVE CREW SERVED WEAPON (OCSW)

Army ACAT III Program		**Prime Contractor**
Total Number of Rounds:	Over $1M	Primex
Total Program Cost (TY$):	$1,107M (Current POM)	
Average Unit Cost (TY$):	$37K	
Full-rate production:	FY07	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Objective Crew Served Weapon (OCSW) is to be the next-generation crew served weapon replacing the current inventory of M2 (.50 caliber) and Mk 19 (40mm) machine guns. OCSW is expected to utilize newly developed 25 mm high explosive air bursting and armor piercing munitions requiring a laser range finder, ballistic computer, and sensor suite to enhance lethality and suppression capability. The new capabilities of this weapon system will support ***precision engagement*** and ***dominant maneuver*** by dismounted forces in ***Joint Vision 2020***.

BACKGROUND INFORMATION

This system constitutes the weapon sub-system portion of the Land Warrior program. As a result of the Live Fire Test Oversight for Small and Medium Caliber Ammunition Group's meetings, OCSW (specifically, the high explosive air bursting munition) was identified as an LFT&E candidate and placed under DOT&E oversight in December 1996.

TEST & EVALUATION ACTIVITY

The OCSW program will enter Milestone I/II during 3QFY02. At Milestone I/II, this program will transition from Advanced Technology Demonstration status into EMD. There was little or no LFT&E activity for this weapon in FY00. An approved strategy for OSCW is expected to be completed in mid-FY01, well in advance of the MS I/II decision. Dedicated Live Fire testing is expected to occur in FY04.

TEST & EVALUATION ASSESSMENT

A rough draft of the LFT&E strategy was reviewed by DOT&E in FY99. This strategy is similar in concept to that for the Objective Individual Combat Weapon (OICW). However, since OCSW will utilize two new 25 mm rounds against a wide array of threats, more extensive lethality testing will be required.

OBJECTIVE INDIVIDUAL COMBAT WEAPON (OICW)

Army ACAT III Program		**Prime Contractor**
Total Number of Rounds:	Over $1M	Alliant Techsystems
Total Program Cost (TY$):	$772M (Current POM)	
Average Unit Cost (TY$):	<$30 per round – ATD threshold	
Full-rate production:	FY06	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Objective Individual Combat Weapon (OICW) is to be the next-generation infantry weapon to replace the 5.56 mm M16A2 assault rifle, M4 carbine, and M249 squad automatic weapon, along with the 40mm M203 grenade launcher. OICW will fire high explosive air bursting munitions (20 mm) and light-weight kinetic energy projectiles (NATO 5.56 mm). The new capabilities of this weapon system will support ***precision engagement*** and ***dominant maneuver*** by dismounted forces in ***Joint Vision 2020***.

BACKGROUND INFORMATION

This system constitutes the weapon sub-system portion of the Land Warrior program. As a result of the Live Fire Test Oversight for Small and Medium Caliber Ammunition group's meetings, OICW (specifically, the high explosive air bursting munition) was identified as an LFT&E candidate and placed under DOT&E oversight in December 1996.

This program passed its Milestone (MS) I review in February 2000, transitioning from Advanced Technology Demonstration (ATD) status into its Program Definition and Risk Reduction (PDRR) phase. An approved LFT&E strategy for OICW was included in the TEMP supporting this milestone. Dedicated Live Fire tests are expected to occur in FY06.

During an ATD demonstration test in FY99, a high-explosive, airbursting munition experienced an ignition anomaly—causing personnel injury. A root cause analysis was completed in FY00, and a Milestone Ia decision has been scheduled for 1QFY02, to ensure that adequate fixes have been implemented before continuing through PDRR.

TEST & EVALUATION ACTIVITY

LFT&E activity during FY00 focused primarily on the development of an acceptable combined LFT&E strategy and event design plan for OICW.

TEST & EVALUATION ASSESSMENT

The approved LFT&E strategy for OICW, submitted with the MS I TEMP in February 2000, outlines more than 150 shots against a variety of targets in various environments. Although the proposed LFT&E program appears sufficiently robust at this time, the strategy details will need to be refined and updated when the TEMP is resubmitted at MS II in 3QFY04.

PROPHET

Army Programs: PROPHET Ground ACAT III; DTUAV-SIGINT ACAT III

Total Number of Systems	
PROPHET Ground (PG):	83
DTUAV-SIGINT:	14
Total PG Program Cost (TY$):	$68.3M
Average PG Unit Cost (TY$):	$.565M
Total DTUAV-SIGINT Program Cost (TY$):	TBD
Average DTUAV-SIGINT Unit Cost (TY$):	TBD
Full-rate production	
PROPHET Ground:	2QFY01
DTUAV SIGINT:	4QFY05

Prime Contractor

PROPHET Ground: Delphin Systems, Inc. (first 13) DTUAV-SIGINT: pending competition

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The PROPHET is a suite of division-level Signal Intelligence/Electronic Warfare (SIGINT/EW) sensor and jamming sub-systems that operate at or below the collateral SECRET security level. PROPHET consists of two programs: (1) PROPHET Ground, mounted on a High Mobility Multipurpose Wheeled Vehicle (HMMWV); and (2) Division Tactical Unmanned Aerial Vehicle (DTUAV-SIGINT). The DTUAV-SIGINT program consists of two elements: (1) the aerial SIGINT and EW payloads for the Tactical Unmanned Aerial Vehicle (TUAV); and (2) a ground-based workstation to remotely control the mission payload(s) and display the data.

PROPHET's primary mission will be to electronically map radio frequency emitters on the battlefield operating between 20 MHz (High Frequency)) and 2,000 MHz (Super High Frequency).

Electronic mapping is defined as detecting, identifying, locating, and tracking all radio frequency emitters operating within sensor line-of-sight and with sufficient signal strength, and graphically depicting the emitters. PROPHET will also have the capability to select specific emitters/nodes for more accurate geographic location, conduct Electronic Attack (jamming) and Navigation Warfare, and perform tactical voice exploitation. PROPHET has the capability to cross-cue other Intelligence and Electronic Warfare (IEW) and non-IEW sensors. DTUAV-SIGINT will orchestrate the overall SIGINT/EW and Measurements and Signature Intelligence (MASINT) effort within the Division. DTUAV-SIGINT will transmit and receive reports to and from the All Source Analysis System (ASAS) at the Division's and the Armored Cavalry Regiment's Analysis and Control Elements (ACE) and the Brigade's Analysis Control Teams (ACT), providing digital information in near real-time to the common operating picture. The forward deployed PROPHET Ground's major mission is to provide force protection directly to the supported maneuver commanders. The force protection is based upon PROPHET Ground's ability to provide timely opposing-force voice activity reports.

PROPHET will contribute to ***Joint Vision 2020*** by providing Army Division and Brigade commanders with the SIGINT/EW tools necessary to achieve decision superiority. PROPHET directly supports the operational concepts of ***Joint Vision 2020*** by providing situation awareness and force protection in support of ***dominant maneuver,*** and by providing target development and electronic attack in support of ***precision engagement***.

BACKGROUND INFORMATION

The concept for the PROPHET program was initiated in 1998, following unfavorable results from DT and Combined DT/OT of the Intelligence and Electronic Warfare Common Sensor (IEWCS) program. IEWCS consisted of three Army systems: (1) the Army Ground-Based Common Sensor-Light (GBCS-L); (2) the Army Ground-Based Common Sensor-Heavy (GBCS-H); and (3) the Army Advanced Quick Fix (AQF). The collective operation of GBCS-L, GBCS-H, and AQF was designed to support Army divisions with signal detection, identification, location, and jamming (a growth capability). It was also supposed to provide nominal geo-location accuracy using time-difference of arrival techniques when operating with a baseline of three or more systems and a degree of accuracy suitable for targeting when using differential Doppler techniques involving a combination of AQF and ground-based platforms.

The emerging test results from GBCS-L combined DT/OT found the system to be neither effective nor suitable. Geo-location accuracy and reliability were not achieved during earlier DT, and fell short of users requirements. The system could not be fully tested against threat targets in all frequency bands due to antennae calibration limitations encountered prior to the tests and software problems encountered during the tests. For the third time, the system was deemed not ready to undergo IOT&E. This caused the Army portion of IEWCS to be discontinued and led to a congressional request for an audit of IEWCS by the DoD Inspector General.

The DoD Inspector General's findings stated that the program was not managed efficiently or effectively. As a result: (1) IEWCS spent nine years in the engineering, manufacturing, and development phase; (2) the Army spent $902 million on development and procurement; and (3) the Government accepted seven limited procurement urgent Ground-Based Common Sensor-light systems that never passed initial operational test and evaluation (and planned to accept five more systems upon production close out).

These findings forced the Army to come up with a new tactical SIGINT strategy and a restructured program—PROPHET—to implement this strategy. The Army's first step in this transition is to field PROPHET Ground as a replacement for the Army's aging tactical SIGINT legacy systems: Teammate, Trailblazer, Trafficjam, and the AN/PRD-12.

TEST & EVALUATION ACTIVITY

The PROPHET Test Integrated Product Team has developed the TEMP for PROPHET Ground, which was approved in October 2000. The Division TUAV SIGINT Program (DTSP), formerly PROPHET Air, is under development by the DTSP T&E IPT. Similar problems exist in both programs for requirements definition and program development. AEC, OTC, and DTC have been active in assisting the TSM and PM in the development of key documents to essentially allow development of both Test and Evaluation strategies for PROPHET Ground and Division TUAV SIGINT.

Phase 1 Initial Operational Test (IOT) for PROPHET Ground Block 1 (PGB 1) began October 27, 2000, and was completed November 11, 2000. Phase 2 test for PGB1 consisted of an over the shoulder assessment of 313th MI Battalion employment of the PGB1 system. Results from developmental testing, the Joint Contingency Force Advanced Warfighting Experiment (JCF AWE), and the PGB 1 IOT Phase 1 and 2, will provide input to the Milestone III scheduled for March 31, 2001. PG Block 2 is attempting to go to IOT in 4QFY01. Documentation to support PG Block 2-5 has yet to be completed.

DTSP is currently trying to achieve a Milestone B decision by 2QFY01. The T&E IPT is attempting to generate the evaluation strategy based on draft documentation. EPG/WSMR, DTC is scheduled to support the PM in the product demonstrations during the November/December 2000 timeframe to help the TSM and the PM refine requirements and reduce RDT&E costs associated with DTSP development.

TEST & EVALUATION ASSESSMENT

Based on past test experience with the Intelligence and Electronic Warfare Common Sensor program, PROPHET operational testing is taking place in a more dynamic and realistic environment than the static developmental testing range configuration used in prior Army SIGINT OTs. DOT&E has been working with the Army testers to ensure that phases of operational testing to support each milestone will be conducted in an operational environment as part of field training exercises. This is evident in the Phase 2 PGB 1 IOT conducted at Ft. Bragg, NC, during an airborne brigade FTX and the use of AWE information to augment the evaluation.

Test planning has been hampered by the lack of approved Operational Requirements Documents (ORD). The Army Training and Doctrine Command (TRADOC) finally approved the ORD for PROPHET Ground in July 2000. The PROPHET Product Manager completed the PROPHET Ground TEMP in time to support the start of IOT, and the Army Evaluation Center completed the System Evaluation Plan within two months of receiving the approved ORD and COIC. Although the start of PROPHET Ground Block IOT was in jeopardy, the T&E IPT worked to ensure that all documentation necessary to proceed to IOT was completed on time. DOT&E involvement throughout this process was crucial in the staffing and approval of key T&E documents to support the IOT start date.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

The subject matter expertise within DOT&E can contribute to the development of Concepts of Operations (CONOPS) for the employment of new systems. In the case of PROPHET Ground, the materiel development proceeded at a faster pace than the development of CONOPS. DOT&E assisted the TRADOC System Manager-PROPHET in coming up with a viable CONOPS for IOT&E and potential fielding of the system.

RESERVE COMPONENT AUTOMATION SYSTEM (RCAS)

Army ACAT IAM Program

Total Number of Workstations:	56,000
Total Program Cost (TY$):	$972M
Average Unit Cost (TY$):	$17K
Life Cycle Cost (TY$):	$2,530M
Initial Operating Capability:	2QFY97
Full Operating Capability:	1QFY03

Prime Contractor

Science Applications International Corporation (SAIC)

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Reserve Component Automation System (RCAS) is an automated information system that supports commanders with information needed for Reserve Component mobilization and day-to-day administrative operations. It is a sustaining base networked system of workstations, primarily employing Commercial-Off-The-Shelf (COTS) and Government-Off-The-Shelf (GOTS) software applications. RCAS will interface with numerous existing and future Standard Army Management Information Systems, certain National Guard standard systems, and systems designated by the Office of the Chief, Army Reserve. RCAS supports the ***Joint Vision 2020*** concept of ***information superiority*** by supporting the readiness of the Army Reserve Components, increasing their responsiveness and enabling them to rapidly integrate into joint organizations. Further, RCAS provides the communications and coordination capabilities necessary to mobilize the Army Reserve Components.

RCAS is scalable and compliant with open systems environment standards. The current base system employs the Microsoft Windows NT® operating system. Office automation tasks use Microsoft Office® applications. A separate application, JetForms®, is used for creating and maintaining forms. Government-off-the-shelf software applications and interfaces, such as Unit Level Logistics System, Standard Property Book System-Redesigned, and Standard Installation/Division Personnel System Version 3, will be incorporated in several increments.

BACKGROUND INFORMATION

In 1979, the Secretary of the Army approved a Mission Element Need Statement for an automated data system to support the mobilization process of the Reserve Components. This need was addressed with the Army Continental Army Management Information System (CAMIS), begun in the early 1980s, but canceled in 1985. CAMIS was then reprogrammed in 1986 (as RCAS) under the provisions of OMB Circular A-109. The RCAS acquisition was placed under the control of the Chief, National Guard Bureau, with advice of the Congress and the Chief, Army Reserve. The original Mission Need Statement for the RCAS program was approved in September 1988. RCAS was initially precluded from using any government-furnished hardware or software. The development contract was awarded to Boeing Computer Services, Inc. (now SAIC) in 1991.

The RCAS Program Management Office (PMO) held a Limited User Test in August and September 1992 to demonstrate basic RCAS capabilities, but major deficiencies were found. After several attempts to correct system shortcomings, the program was restructured in 1995, and the restriction regarding government-furnished elements was removed. A beta demonstration was conducted for the restructured RCAS program at several Army Reserve and Army National Guard sites in fall 1995. Subsequently, the Army Validation Assessment Team accepted the revised RCAS solution. The mission needs were revalidated in April 1996.

During the summer of 1996, Army OPTEC conducted IOT&E for the core elements of RCAS, Increment 1, consisting of the Windows NT® Local Area Network servers and the basic user PC (Pentium®) workstations, Microsoft office automation, and e-mail applications. A mobilization training exercise was included as a test event. IOT&E was conducted at 11 sites (34 units) of the Iowa Army National Guard and 6 sites (11 units) of the 99th Regional Support Command of the U.S. Army Reserve in western Pennsylvania. Based upon IOT&E, Increment 1 of RCAS was judged to be operationally effective and suitable provided the functional users augment the system administrator staffing and the PM improve training, logistics support, and security procedures. An abbreviated assessment was later conducted and the results showed that the revised training plan and updated procedures were adequate.

An OT&E of RCAS Increment 2 was conducted by the Army OPTEC from September-October 1997. Five critical operational issues and five additional operational issues were evaluated during the 22-day test period. The major new elements added to RCAS in Increment 2 were the Unit Level Logistics System-Ground, Unit Level Logistics System-S4, and the Standard Property Book System-Redesign. OT&E was conducted at 13 sites (39 units) of the Iowa Army National Guard, employing 563 workstations (38 Classified). In addition, OT&E included 62 sites of the 99th Regional Support Command of the U.S. Army Reserve, involving 441 workstations (18 Classified) located among 105 units in Pennsylvania, West Virginia, Maryland, and Virginia.

Increment 2 testing results showed the system to be operationally suitable and survivable, but not effective due to poor connectivity at small sites and inadequate forms processing. The PMO fixed these problems and OPTEC conducted a follow-on OA to determine whether the fixes were successfully made.

After reviewing the test results, DOT&E determined that RCAS Increment 2 was operationally effective and suitable on December 10, 1997.

TEST & EVALUATION ACTIVITY

A Limited User Test (LUT) of RCAS Increment 3 was conducted in July 1999, with follow-on testing activities in September at: eight Iowa Army National Guard sites (46 users), 99th Regional Support Command in Pennsylvania (3 users), U.S. Army Reserve Command in Georgia (21 users), and National Guard Bureau in Virginia (12 users).

RCAS Increment 3 provides a number of new COTS/GOTS applications, including the Federal Logistics System and the Standard Army Training System. Three previously fielded GOTS applications were upgraded, including Unit Level Logistics System-Ground, Unit Level Logistics System-S4, and Standard Property Book System-Redesign. In addition, the RCAS PMO developed three new applications, including Force Authorization, Commander's Clipboard, and Unit Personnel System/Command Management System.

The primary focus of the Increment 3 LUT was on the normal day-to-day usage of the newly added and upgraded application capabilities. Further, regression testing of the Increment 1 and 2 office automation and mobilization planning capabilities was conducted to ensure that they remain operationally effective and suitable. The system performance, reliability, and ability of the RCAS end-users to perform mission tasks using RCAS in daily unit operations provided the basis for OPEVAL.

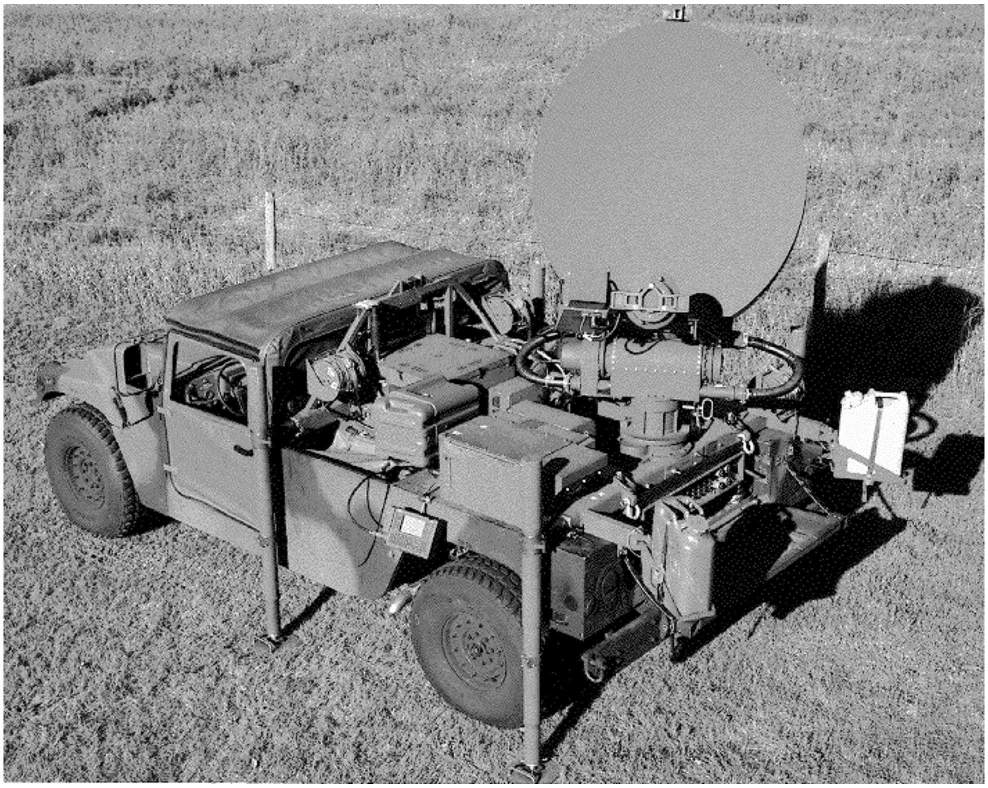
TEST & EVALUATION ASSESSMENT

Test results showed that the fundamental computing infrastructure, consisting of personal computers, Microsoft NT operating system, and COTS network systems, continued to perform well. The e-mail and file transfer capabilities were used successfully to exchange messages and documents. Three upgraded applications: Unit Level Logistics System-Ground, Unit Level Logistics System-S4, and Standard Property Book System-Redesign, remain robust. In addition, the two new GOTS applications—the Federal Logistics System and the Standard Army Training System—also performed well.

The test data collected by ATEC during the LUT was not sufficient to conclusively determine the effectiveness and suitability of the new applications: Emergency Information System, Force Authorization, and Commander's Clipboard. As a result, DOT&E recommended to the Information Technology Overarching Integrated Product Team that additional test data be collected to complete OPEVA. The additional data collection completed in February 2000. After some corrections were implemented in the Force Authorization application, the increment was judged operationally effective and operationally suitable.

The RCAS PMO has combined the capabilities for the originally planned Increments 4 and 5 into a single increment for operational testing scheduled for November 2000. DOT&E will continue to work with the Army Reserve Component functional communities, ATEC, and the RCAS PMO to maintain the effectiveness and suitability of RCAS with each added capability.

SECURE, MOBILE, ANTIJAM, RELIABLE, TACTICAL TERMINAL (SMART-T)



Army ACAT IC Program		Prime Contractor
Total Number of Systems:	318	Raytheon
Total Program Cost (TY$):	$1.28B	
Average Unit Cost (TY$):	$2.4M	
Full-rate production:	1QFY99	
Production Decision for AEHF Upgrade:	4QFY04	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Secure, Mobile, Anti-jam, Reliable, Tactical Terminal (SMART-T), a Military Strategic and Tactical Relay (MILSTAR) satellite communications transmit and receive terminal, is a core element of the Joint Service ground terminal segment of the MILSTAR satellite system. The primary SMART-T mission is multi-channel, near global extended range connectivity for the Army's Mobile Subscriber Equipment, which is the primary tactical communications equipment for corps and division operations. Operating at both the MILSTAR low (75-2400 bits/second) and medium (up to 1.544 mega-bits/second) data rates, it is designed to provide tactical commanders with secure, jam resistant, extended range, two-way, point-to-point and network voice, data, and video communications. In addition to overcoming the limitations of terrain masking and distance, SMART-T is designed to operate and survive in severe electronic warfare and nuclear, biological, and chemical environments. These characteristics should enable our forces to maintain ***information superiority*** throughout all levels of conflict, support the ***full-***

dimensional protection operational concept, and ensure that warfighters retain freedom of action through continuous, secure communication.

BACKGROUND INFORMATION

SMART-T entered the EMD phase in May 1992, and the low-rate initial production phase in February 1996. The SMART-T acquisition strategy was designed to deliver terminals in advance of the first Medium Data Rate (MDR) MILSTAR satellite being placed in orbit. The strategy does not require the terminals to demonstrate all operational effectiveness and suitability requirements during IOT&E and prior to the Milestone III full-rate production decision. The Program Office executed the first of three planned SMART-T full-rate production options in January 1999 based on IOT&E results. Further production options beyond the current 89 terminals were to be supported by additional operational tests in 4QFY99 using an on-orbit MDR satellite. However, the April 30, 1999 launch of the MILSTAR Flight 3 satellite failed. Consequently, the planned test has been delayed until after the next MILSTAR launch in 2QFY01. The Army Acquisition Executive approved a revised APB reflecting a new schedule for FOT&E and IOC on September 26, 1999.

TEST & EVALUATION ACTIVITY

SMART-T IOT&E was conducted June 1-12, 1998, at Ft. Gordon, GA, using eight production representative terminals. The test used an on-orbit MILSTAR satellite for LDR communication and the Massachusetts Institute of Technology (MIT)/Lincoln Laboratory MDR/LDR satellite simulator for MDR communications. SMART-T's were deployed replicating a typical division and corps Area Common User System. The terminals were moved over improved and unimproved roads with varying conditions designed to stress the system and soldier/machine operations and demonstrate operational suitability of SMART-T.

There were two major limitations to SMART-T IOT&E:

- As there was no MDR-capable MILSTAR satellite on orbit, the MIT/Lincoln Laboratory satellite simulator was used MDR communications. The satellite simulator does not replicate all the physical acquisition and tracking characteristics of an orbiting satellite, nor does it replicate the delay times or footprint associated with an orbiting satellite. Testing of the on-orbit satellite will be delayed until after MILSTAR Flight 4 is launched in late 2000. This testing will be conducted under operationally realistic conditions to replicate Mobile Subscriber Equipment range extension operations.

- The Automated Communications Management System (ACMS—an objective communications management tool used for MILSTAR network planning and management control) was not available during the test. ACMS is an interim planning tool used to do the network planning for IOT&E. ACMS is still under development but is expected to be available to support MILSTAR Flight 4 strategic (LDR) operations in 2000.

The Program Manager conducted a RAM confidence demonstration in April 1999 to substantiate the improvements made to SMART-T since IOT&E. Additional Reliability Growth Testing (RGT) has demonstrated a terminal reliability of 489 hrs Mean Time Between Failure (MTBF) at 80 percent LCL.

The on-board SMART-T diesel generator successfully demonstrated its required reliability of 500 hrs MTBF at 80 percent LCL during RGT in fall 1999.

TEST & EVALUATION ASSESSMENT

DOT&E reported the results of the June 1-12, 1998 IOT&E in our B-LRIP report to Congress in January 1999. Sufficient progress in system reliability has not been demonstrated in developmental testing and verified through operational testing to warrant changing the basic assessment of SMART-T operational effectiveness and operational suitability. We note, however, that the Program Office is making significant progress in addressing shortcomings. The major issues from the B-LRIP are summarized below:

- Operational effectiveness could not be fully demonstrated because ACMS was not available for IOT&E and there was no MDR MILSTAR satellite in orbit. Additionally, a SMART-T orderwire (an initial, rudimentary communications link) was not planned for or used during IOT&E. The Program Office has planned for an orderwire with SMART-T, and is fielding baseband devices to support the orderwire.

- SMART-T is not operationally suitable. The most serious shortfall occurred in achieving the expected operational reliability. Field test results for MTBF were only 50 hours (point estimate). Also, the observed Mean Time Between Operational Mission Failure was 43 hours (point estimate) in IOT&E. This is substantially below the 700-hour requirement the system must demonstrate prior to a fielding decision. Failures were attributed to a wide range of software, hardware, training, procedural issues, and operator errors.

- SMART-T is operationally survivable. The performance was evaluated using contractor and independent laboratory tests and analyses, models, and open-air tests.

Cold weather setup/teardown testing of a SMART-T was conducted at the Cold Region Test Center (CRTC), Ft. Greely, AK, from November 8-18, 1999. Thirteen setup and teardown sequences were successfully performed. This test successfully demonstrated that SMART-T can be setup and tore down by a two-man crew wearing cold weather gear within the 45 minute ORD requirement.

CONCLUSIONS

The Program Office has made significant improvements to SMART-T since IOT&E in June 1998, and DOT&E is confident that the program is on its way to becoming operationally effective and suitable. However, the following conclusions remain valid:

- Operational effectiveness has not been fully demonstrated, and cannot be confirmed until the MILSTAR communication management system is fully developed and operationally tested. This testing should take place in mid-year 2001 after the launch of MILSTAR Flight 4.

- SMART-T is not operationally suitable. Although the program office has made numerous modifications to improve reliability and other system shortfalls, none of the fixes have been verified in an operationally realistic test. Additionally, although MTBF has grown to over

450 hours (80 percent lower confidence level), the required 800-hour level (the entrance for follow-on operational testing) has not been demonstrated.

- Operational survivability is satisfactory.

RECOMMENDATIONS

The following recommendations are based on observations from the June 1-12, 1998 IOT&E and Program Office activities since that time.

- A fielding decision should not be made until operational testing confirms that SMART-T is both operationally effective and operationally suitable.

- In order to meet operational reliability requirements, the Program Office should continue executing an aggressive growth program until SMART-T demonstrates that it meets technical reliability requirements and entrance for follow-on operational testing.

Additionally, DOT&E recommends that the following items receive special attention during future operational tests and evaluations:

- Improvements in training, troubleshooting procedures, and technical manuals must be verified in operational testing.

- The numerous user man/machine interface shortcomings must be corrected. Additionally, the SMART-T terminal should be evaluated for overall quality of construction.

- Integrated logistics issues such as poor computer screen readability in sunlight, inadequate audible alarms, and poor placement of generator switches must be corrected.

- DOT&E recommends that SMART-T be evaluated for vulnerability to non-nuclear, high-power microwaves to determine its ability to withstand this emerging threat.

DOT&E will continue oversight of SMART-T and work with the Program Office, the Army, and the operational test community to further refine test requirements and ensure that SMART-T is operationally effective and suitable prior to fielding.

SENSE AND DESTROY ARMOR (SADARM)

Army ACAT IC Program*

Total Number of Systems:	47,331
Total Program Cost (TY$):	$3,075.8M
Average Unit Cost (TY$):	$65,000
Full-rate production:	FY05

* *Program plan before restructure*

Prime Contractor

GENCORP Inc. (Aerojet)

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Sense and Destroy Armor (SADARM) is a "smart" artillery submunition designed for ***precision engagement*** of self-propelled howitzers as well as other lightly armored vehicles. By destroying the enemy's self-propelled counterfire capability, SADARM contributes to ***full-dimensional protection***. Denying the enemy's use of self-propelled howitzers better enables friendly forces to move at will and ***dominate maneuver***.

SADARM is designed to attack and kill lightly armored vehicles. Each 155 millimeter (mm) howitzer round delivers two submunitions. Once dispensed, the submunition deploys a parachute-like deceleration device. At a pre-determined distance from the ground, the submunition ejects the deceleration device and deploys another device to stabilize and rotate the submunition. As the submunition falls and rotates, it searches the ground with a millimeter wave sensor (both active and passive) and an infrared sensor array. Using the sensors and detection logic, the submunition is designed to detect countermeasured targets in a variety of climates. If the sensors detect a target, the submunition fires an Explosively Formed Penetrator (EFP) at the target. If no target is detected, the submunition is designed to self-destruct.

At the start of FY00, the Army had planned to keep Basic SADARM in low-rate production, and to develop a SADARM Product Improvement (PI) for eventual full-rate production. During FY00, the Army decided instead to pursue a modified product improvement called SADARM Basic+ that would improve submunition reliability and sensor performance as well as integrate the SADARM submunition into an extended range 155mm round (Excalibur). However, neither this program nor Basic SADARM is currently funded.

BACKGROUND INFORMATION

SADARM entered low-rate production in March 1995. Testing prior to this decision showed poor reliability at the longest range. Technical testing from 1996-1998 showed improvement in submunition reliability at the longest range, but still below the 80 percent reliability requirement. By the beginning of 1998, reliability at 15 kilometers was approximately 70 percent. In addition, an incompatibility between the SADARM round and the electronic fuze was discovered. Although the Army decided to field basic SADARM with only the mechanical fuze, the Army continues to investigate this incompatibility. There were also a number of critical technical tests at Yuma Proving Ground, Arizona, and Ft. Greely, AK, to test SADARM's capabilities in a variety of countermeasures and environments. The weather varied from rain to sun to snow. All of the tactical rounds were fired at 15 kilometers, where submunition reliability was greatest. In general, SADARM performed well in these technical tests.

An IOT&E was conducted in August 1998 at Ft. Greely. The DIA-validated array was nearly identical to the defensive array used in the Ft. Greely technical tests. All of the targets were real threat vehicles. All five missions of 24 rounds each (120 total) were fired at 19.4 kilometers. The Army validated this as a likely range for the operational test scenario. Besides range, the other major difference between the operational and technical tests was firing procedures and thus accuracy. During the IOT, soldiers generated the inputs and calculated the ballistic solutions using equipment, software, and methods representative of what would be available when SADARM is fielded. The operational test results were well below requirements.

The major LFT&E activities were completed in FY98. To augment the lethality data from about 30 impacts on a variety of threat vehicles during end-to-end technical test firings, a seven-shot tower test against 2S3 SPHs and a T-72 tank was conducted at Aberdeen Proving Ground, MD. Also, the impacts on actual threat targets during IOT provided valid additional data for the live fire assessment.

TEST & EVALUATION ACTIVITY

Technical testing in 1999 and 2000 focused on improving submunition reliability. After the contractor conducted numerous reliability tests (including high stress firings) in 1999, the Government fired tactical rounds at 17 and 19 kilometers at ambient desert temperature throughout 1999 and 2000. These technical tests were conducted at Yuma Proving Ground against a large non-operational target array.

A Limited User Test (LUT) was conducted in April and May 2000 at Yuma Proving Ground. This test was to support a fielding decision of a limited number of basic SADARM rounds. The DIA-approved target array and countermeasures were operationally representative of the Southwest Asia scenario. All four missions of 24 rounds each (96 total) were fired at 19 kilometers. Target location errors were drawn from operationally representative data of the AN/TPQ-37 Firefinder radar. The Army conceded one of the missions due to a large targeting error, so an additional targeting error was selected. The conceded mission was scored as zero kills. Missions were fired at 4:00 a.m., 6:00 a.m., 12:00 p.m., and 2:00 p.m.

The SADARM TEMP was revised and approved by OSD in mid-FY00. However, because the TEMP addresses the unfunded PI SADARM T&E program, it is no longer current.

TEST & EVALUATION ASSESSMENT

In 1998, DOT&E assessed the system to be not operationally effective and not operationally suitable. Major factors in this assessment were variable submunition effectiveness, reliability, and delivery accuracy. Submunition effectiveness varied depending on factors including realistic target emplacement in foliage, countermeasure nets, heat sources such as fires, exhaust, or expended shell casings, and time of day. Winds affected submunition delivery accuracy and operational effectiveness during some missions fired. One mission was canceled to avoid high wind conditions. An additional mission was canceled due to the expectation of inaccurate delivery and a third mission was conceded due to a large targeting error. Low submunition reliability, estimated to be 44 percent versus 80 percent required, was a significant factor in the overall assessment. Even when test conditions appeared to be favorable, SADARM still did not meet its effectiveness requirement.

DOT&E's 1998 assessment included a Live Fire lethality evaluation of the basic SADARM warhead, which concluded that it is capable of damaging or destroying its expected primary threat targets, given that it strikes them. SADARM also has some capability against tank targets, but to a lesser degree.

Technical testing in 1999 and 2000 demonstrated that there has been some progress in submunition reliability since the 1998 IOT&E. A reliability of 74 percent (20/27) was scored for 15 rounds fired with lower powder charges at 17 kilometers in August 1999. During that same test period, seven rounds fired with the highest powder charge at 17 kilometers were scored as 86 percent (12/14) reliable. All other tests were conducted with the highest powder charge at a 19-kilometer range. Results under ambient desert conditions were 73 percent (11/15) in September 1999, 69 percent (11/16) in January 2000, and 67 percent (10/15) in March 2000. Each of these tests used slightly different submunition design and/or production techniques. There were additional tests of rounds conditioned hot (145º F) and cold (-26º F). Hot conditioned submunitions scored 100 percent (8/8) in January 2000 and 83 percent (20/24) in March 2000. Cold conditioned submunitions scored 63 percent (5/8) in January 2000 and 88 percent (7/8) in March 2000.

Since each of these reliability test events had a different configuration, it is inappropriate to combine the results. The reliability of ambient rounds at a 19-kilometer range appeared to decrease over time (September 1999 to March 2000) and the conditioned rounds appeared to have a higher reliability than the non-conditioned rounds. In addition, the reliability at 17 kilometers is similar to results observed in 1997 (73 percent (71/97)). DOT&E's best estimate is that current submunition reliability at the longest range is approximately 70 percent.

SADARM exceeded the Army's kill requirements in the LUT, despite not meeting the submunition reliability requirements. The results were 1.4 times the required kills for five missions. This includes a score of zero kills for the mission conceded because of large targeting error. Reliability of LUT submunitions was estimated to be 72 percent (43/60) versus 80 percent required. Because the tactical submunition is not instrumented, reliability scoring is very subjective. It is difficult to separate unreliable submunitions from reliable submunitions that did not detect targets. Accurate reliability scoring is even more difficult during operational tests, such as the LUT, where countermeasures reduce detection probabilities.

While SADARM met its operational effectiveness requirements in the desert LUT, it is not clear whether the currently designed round could pass a retest at Ft. Greely. While submunition reliability appears to have improved since the IOT&E, reliability was not the only issue in the 1998 IOT&E. Wind effects and submunition effectiveness in the Ft. Greely environment are still important factors that will affect operational effectiveness. An operational test at Ft. Greely is required to determine whether the current system would pass its requirements in a verdant summer environment.

Despite meeting the LUT requirement, it appears that the Army's doctrine of firing 24 rounds at each battery-sized target is inefficient. With one exception, the howitzers that were killed during the LUT were hit in the first 12 rounds. Even for that mission, however, the requirement was met in the first 12 rounds. For howitzers with multiple hits, it is difficult to determine which hit killed the target. As was observed during firings in prior technical testing and IOT, howitzers that are hit are generally killed. In addition, 60 percent (114/190) of the submunitions had no threat vehicle in their footprint. This may be improved by leveraging Firefinder's increased accuracy in locating individual howitzers (as opposed to the entire threat battery). A doctrine that targets individual howitzers, rather than the whole battery, may provide a more efficient use of SADARM rounds.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

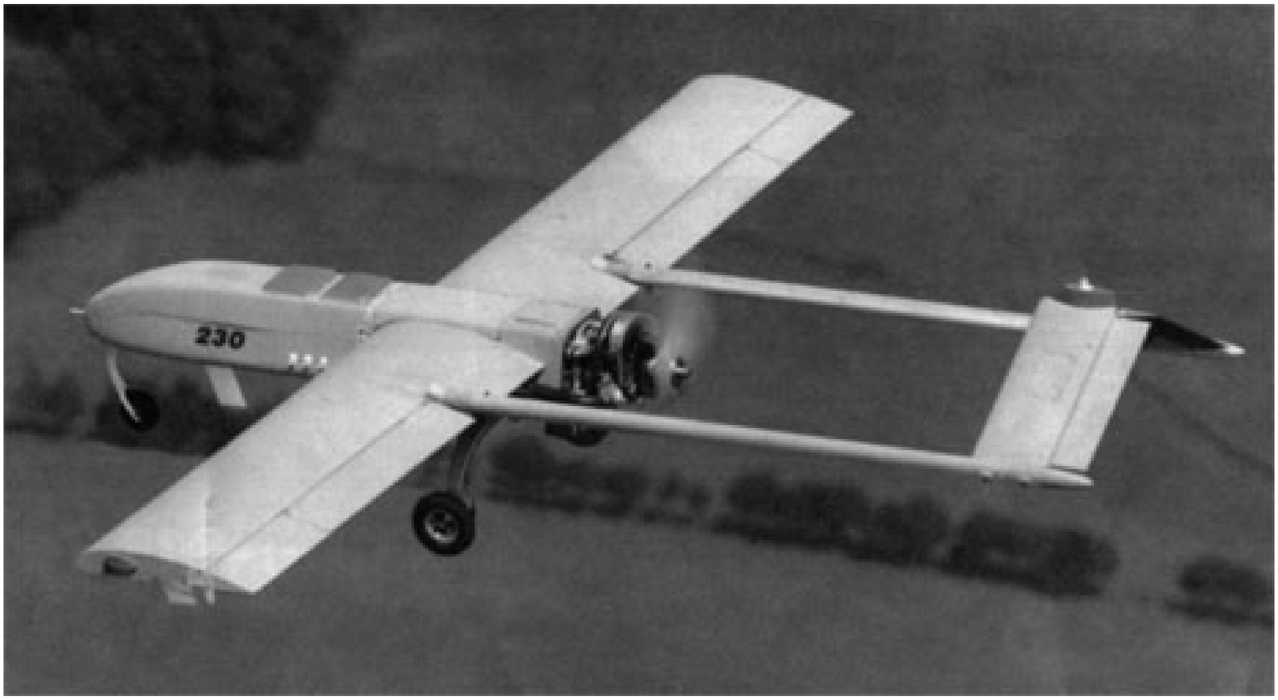
The basic SADARM test program was highly successful at integrating a variety of actual threat vehicles into target arrays for the technical tests, IOT, and LUT. The result was a six-fold increase in the number of data points available to support the live fire evaluation over what would have been available from only the dedicated tower test. If a product improvement to SADARM is developed and tested, a similar approach should be followed.

Instrumentation of the tactical round is required. This instrumentation would help isolate specific reliability problems as well as provide reliability data. An instrumented round provides greater efficiencies in testing and fault tree assessments. An overall improved submunition reliability would result.

A change in firing techniques is strongly recommended. There is inefficiency in the current number of rounds employed against each target. In the LUT, 60 percent of the submunitions did not have a target in their footprint. A firing doctrine that maximizes the use of the Firefinder radar's accuracy in locating individual threat howitzers should be considered.

Operational test results indicate that SADARM may have significantly reduced effectiveness in environments in which the probability of detection of individual threat targets is known to be low. The Army should consider tactical changes (such as firing more rounds in these conditions) or a redesign of the submunition target detection algorithm.

SHADOW 2000 TACTICAL UNMANNED AERIAL VEHICLE (TUAV) SYSTEM



Army ACAT II Program		**Prime Contractors**
Total Number of Systems:	44	AAI Corporation
Total Program Cost (TY$):	$738.9M (RDT&E and Procurement)	
Average unit Procurement cost (TY$)	$ 8.0M	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Tactical Unmanned Aerial Vehicle (TUAV) system is a ground maneuver brigade commander's primary day/night reconnaissance, surveillance, target acquisition, and battle damage assessment system. The TUAV provides the commander with a number of benefits to include: enhanced situational awareness, a target acquisition capability, ability to conduct battle damage assessment, and enhanced battle management capabilities. The combination of these benefits contributes to the commander's dominant situational awareness allowing him to maneuver to points of positional advantage with speed and precision in order to conduct decisive operations. The TUAV, in conjunction with other systems, will provide the tactical commander with ***information superiority*** contributing to the ***full-dimensional protection*** of his force and ***precision engagement*** of the enemy.

The Shadow 200 is a small, lightweight, tactical UAV system. A system comprises three air vehicles, two HMMWV-based ground control stations, an air vehicle transport HMMWVs, two HMMWVs with trailers for personnel, a HMMWV with Maintenance Shelter, one portable ground control station, and four remote video terminals. The air vehicle has a gross take-off weight of 350 pounds with a wingspan of 13 feet. It can carry a 60-pound payload and is currently equipped with the

POP 200 electro-optic and infrared camera. The POP 200 provides full motion color TV and infrared video. The maximum range is 125 kilometers (limited by data link capability), and the air vehicle can loiter up to four hours at 50 kilometers. Operations are generally conducted from 8,000 to 10,000 feet above ground level during the day and 6,000 to 8,000 feet above ground level at night. Automatic landing and take-off can be from unimproved areas as small as 100 meters by 50 meters.

The operational tempo calls for the TUAV to provide 12 hours of continuous operations on station within a 24-hour period. The system will be required to surge to 18 hours within a 24-hour period for up to three consecutive days. After 72 hours, the TUAV system may be reconstituted during a recovery day when the operational tempo requires only 8 hours of operations on station within 24-hour period. The system must be able to keep pace with the brigade's movement and rapid setup and tear down times are required. The control of the air vehicle may be passed between from other control stations or the portable ground control station to facilitate rapid movement and allow continuous flight operations.

BACKGROUND INFORMATION

In October 1995, JROC recommended termination of the Hunter Short Range Joint Tactical UAV (JTUAV) program and proposed an ACTD approach to satisfy JTUAV requirements and complement the newly developed Predator endurance UAV. In May 1996, the Joint Program Office awarded Alliant Techsystems a two-year ACTD contract to deliver six complete Outrider systems with spares by March 1998. The Outrider program experienced many setbacks and delays. Military participation in the program was reduced from two years to two months, and this limited the Services' ability to fully assess the Outrider's military utility. In November 1998, the JROC directed the Navy and the Army to pursue separate air vehicle solutions to satisfy their tactical UAV requirements. The JROC subsequently validated the Army's TUAV ORD in March 1999 and approved three Key Performance Parameters: MOGAS fuel for the air vehicle and generators, day/night passive imagery payload, and C^4I interoperability with the Army's Joint Tactical Architecture, the Army Battle Command System (ABCS), and JSTARS Common Ground Station.

The Army conducted a systems capability demonstration (SCD) with four contractors participating during October and November 1999 at Ft. Huachuca, AZ. The SCD was used to establish the baseline for system technical and operational performance, and was a significant evaluation factor during the TUAV source selection process. The U.S. Army Test and Evaluation Command provided the source selection board an assessment of each system's potential operational effectiveness and suitability. In December 1999, a Low Rate Initial Production contract was awarded to AAI, Corporation for four Shadow 200 TUAV Low Rate Initial Production systems. The program manager is using a best value approach; i.e., allowing the contractor to trade-off threshold performance characteristics in order to meet higher priority requirements.

Although JROC encouraged the Army to pursue a system that could operate at 200-kilometer ranges and permit a single TUAV system to meet all the Army's UAV requirements, the Shadow 200 is limited in range, endurance and payload capacity. A Block II study is currently underway to define a TUAV system that will come as close as possible to the objective requirements of the TUAV program.

TEST & EVALUATION ACTIVITY

The TEMP was approved prior to the Milestone II and contract award. The document is being updated and will be coordinated prior to the next Milestone.

No operational testing was conducted this year on the Shadow 200. The first flight of the Block 0 Shadow 200, since the SCD, took place June 5, 2000 at Aberdeen Proving Ground, MD. The prime contractor Block 0 flight tests are to evaluate components planned for the Block I Low Rate Initial Production systems. The conversion from Block 0 to Block I involves the integration of several systems into the TUAV like the Tactical Automatic Landing System and the POP 200 payload.

The first Block I system arrived at Ft. Huachuca, Arizona in December 2000 for system performance and government acceptance testing. Training of military operators will begin October 30, 2000 and will consist of 4 weeks in the classroom and 2-3 weeks of flight operations. A second system will be delivered to Ft. Huachuca in order to complete training.

In February 2001, an OP TEMPO test will be conducted at Ft. Huachuca, AZ and Ft. Hood, TX. The majority of testing will take place at Ft. Huachuca, with the remainder of the testing focusing on C^4I taking place at Ft. Hood. This test is to reduce risk prior to IOT&E, and will evaluate critical technical parameters, demonstrate the OMS/MP, and assess C^4I connectivity in the Brigade TOC. The IOT&E test unit and first unit equipped is the 1st Brigade of the 4th Infantry Division. The 4th ID uses more advanced versions of the ABCS than the rest of the Army. This could create some problems for testing the Shadow 200 since one of its KPPs is interoperability with the ABCS. The plan is to test the Shadow 200 with the lower version of ABCS in a laboratory environment and fully certify interoperability in follow-on testing and evaluation. IOT&E is scheduled to begin in April 2001 at Ft. Hood, TX.

On account of the compressed schedule between contract award and IOT&E, the JROC-required interoperability with the tactical control system will be integrated as a block upgrade.

TEST & EVALUATION ASSESSMENT

On June 12, 2000, one of the prototype air vehicles went into a sudden spin at 1,500 feet above ground level. An external pilot was able to stop the spin but was not able to arrest the descent and impact. The airframe was a total loss. An accident investigation found the likely cause of the spin entry was a short or open 15 volt avionics power supply; however, it is not know what caused the short or why the external pilot was not able to control and land the air vehicle. A 3-week delay in testing occurred while another prototype air vehicle was properly configured.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

Commercial off-the-shelf and non-developmental UAV programs to date have not stood up to the rigors of operational environments. The OP TEMPO test should include as much operational realism as possible, including the use of military operators and the deployment of realistic operational targets for assessing UAV image quality and final products.

SINGLE-CHANNEL, ANTI-JAM, MAN-PORTABLE (SCAMP) TERMINAL BLOCK I

Army ACAT III Program

Total Number of Systems:	514
Total Program Cost (TY$):	$210.6M
Average Unit Cost (TY$):	$.215M
Full-rate production:	1QFY94
Production Decision for SCAMP AEHF Upgrade Kits:	1QFY05
Production Decision for SCAMP Block II:	3QFY07

Prime Contractor
Rockwell Collins, Inc.

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Single-Channel, Anti-jam, Man-Portable (SCAMP) terminal is the rapidly deployable component of the Army's Military Strategic and Tactical Relay (MILSTAR) Advanced Satellite Terminal program. SCAMP will draw on the unique capabilities of the MILSTAR system and enable our forces to maintain ***information superiority*** during conflict, and enhance ***full-dimensional protection*** by using anti-jam and low-probability-of-intercept technologies.

The primary mission of SCAMP is to provide survivable extended-range communications to Corps and Division tactical units for command and control. SCAMP's use of MILSTAR's Low Data Rate (LDR) capabilities to interconnect small tactical units eliminates the line-of-sight limitations imposed by land-based radio communications systems. The SCAMP operates in a half-duplex mode at a maximum data rate of 2.4 kbps. The SCAMP program is divided into two separate development efforts: Block I and Block II. Block I will develop an interim 37-pound terminal; Block II will produce a 12-pound terminal.

BACKGROUND INFORMATION

The Milestone III production decision for Block I SCAMP occurred in November 1994. The full-scale production contract for Block I SCAMP was awarded in February 1996. FOT&E for SCAMP was conducted in October-November 1998. FOT&E evaluated the operational effectiveness and suitability of the end-to-end system to support the Army's fielding decision for the Block I terminal.

The Block I SCAMP was re-designated as an Acquisition Category (ACAT) III program in January 1995. The Block II SCAMP remains an ACAT IC program. The SCAMP Block II program is in acquisition Phase 0 awaiting determination of whether the terminal will use only the MILSTAR waveform or include a modified Extremely High Frequency waveform compatible with other satellite programs under development. DOT&E continues oversight of the SCAMP program in order to maintain the system perspective in the oversight of the overall MILSTAR program.

TEST & EVALUATION ACTIVITY

A customer test was performed in a field and garrison operational environment in August 1996 to assess the terminal's progress. This test focused on three operational issues: (1) extending the range for voice and data communications in the field; (2) deployment, setup, and teardown of the equipment; and (3) interoperability with other MILSTAR terminals. On the basis of the customer test, Army Test and Evaluation Command (ATEC) performed an abbreviated OA of the Block I SCAMP terminal.

The SCAMP participated in the MILSTAR system tests involving the Army, Navy, and Air Force terminals in July 1997 and August 1998. In these Medium Data Rate (MDR) focused compatibility and interoperability developmental tests, the Service terminals were bench-connected to the MILSTAR Flight satellite payloads at the contractor's facility in Sunnyvale, CA. The Army's LDR/MDR capable Secure, Mobile, Anti-jam, Reliable, Tactical Terminal (SMART-T) and the Navy EHF Satellite Program (NESP) terminal, equipped with an MDR appliqué, participated in both MDR and LDR tests, while the Air Force Command Post Terminal tested LDR only.

The First Article Test (FAT) ran from April 1997-July 1998. FAT contained sub-test events that verify specific requirements and design characteristics from production specifications. The overall objective of the test was to verify that the SCAMP production terminal conformed to the requirements documents. FAT concluded with a confidence test, which indicated the terminal was ready for operational testing.

SCAMP FOT&E was conducted from October-November 1998 at Ft. Bragg, NC. FOT&E involved a 15-day test of five production terminals in a simulated wartime field environment to evaluate effectiveness, suitability, and survivability. Test scenarios exercised all terminal functions; the terminals were required to demonstrate interoperability with Army Common User Equipment and communicate with higher headquarters and supporting elements of other Services.

ATEC conducted a Limited User Test and Evaluation (LUTE) for the SCAMP Block I terminal in October-November 1999. This test was to provide an evaluation of the corrective actions taken to address the effectiveness and suitability of the terminal. Additionally, it provided the basis for the

Conditional Materiel Release and Fielding Statement released by ATEC on April 10, 2000. For effectiveness, voice quality and message completion rates were evaluated. For suitability, reliability, availability, maintainability, training, technical manuals and troubleshooting were evaluated. The test consisted of nine terminals and over 2,000 hours of operation organized in three 96-hour scenarios.

TEST & EVALUATION ASSESSMENT

ATEC found shortcomings in effectiveness and suitability during 1998 FOT&E, which were significant enough to warrant a failed rating in these two areas. Survivability was rated as marginal based on the need to do further electromagnetic environmental effects testing. The terminal was determined to be survivable in all areas adequately tested.

The 1999 LUTE re-evaluated operational effectiveness and suitability. The SCAMP terminal was assessed not to be effective as employed per the Operational Requirements Document (ORD) dated March 1992 and the Operational Mode Summary/Mission Profile (OMS/MP) dated May 1999. Contributing factors were voice Message Completion Rate (MCR) and setup/teardown times. Data communications met the requirement. The SCAMP terminal was assessed as not suitable as employed per the ORD and OMS/MP. The major factor was RAM.

The SCAMP terminal is required to transmit and receive voice and data messages legibly with a 90 percent call completion rate on a first attempt basis in a wartime mode of operations. See Figure 1. Numbers in parentheses represent performance during FOT&E.

Mode	Point to point	Network	Average performance
Data	95%	95%	95%
Voice	91%	86%	87% (85%)

Figure 1. LUTE Transmit and receive call completion performance

Additionally, during FOT&E SCAMP fell just short of the requirement for voice quality equal to or better than the standard Secure Telephone Unit III (STU III) voice quality.

The SCAMP is intended to be set up or torn down in ten minutes 90 percent of the time. TRADOC has proposed changing this requirement from 10 minutes to 15 minutes, so data was tabulated for both conditions during the LUTE. Whereas performance for setup meets the proposed 15-minute requirement, performance for teardown does not. For both setup and teardown at 10 minutes, performance was worse during the LUTE than during the FOT&E. See Figure 2. Numbers in parentheses represent performance during the FOT&E.

Operation	ORD (10 min)	TRADOC (15 min)
Setup	52% (65%)	91%
Teardown	46% (88%)	85%

Figure 2. LUTE Setup/teardown time performance

The SCAMP met the contractor's specification for altitude, wind, blowing rain, blowing dust, solar loading, high temperature and humidity, and low temperature, but was not tested for blowing sand, fungus, salt fog, leakage and immersion, icing and freezing rain, smoke, aerosol, snow and haze. As tested, the SCAMP performance is unknown if deployed to certain geographic areas such as Korea, Saudi Arabia, Panama, the West Coast of the United States, and Germany.

The SCAMP terminal is required to achieve a Mean Time Between Operational Mission Failure (MTBOMF) of 600 hours (80 percent lower confidence level) in order to provide tactical forces with reliable communications on the move. The system demonstrated only 12 hours MTBOMF during FOT&E. Operational availability was tested during LUTE against the peacetime requirement of 91 percent and the wartime requirement of 92 percent.

	Brigade level	Division, Corps and Theater level	Corps and Theater level only
MTBOMF	72 hours	445 hours	857 hours
Ops availability	61%	90%	Not tested

Figure 3 LUTE MTBOMF test results

CONCLUSIONS

The SCAMP terminal is not operationally effective as a tactical system. Major contributing factors are voice MCR and setup/teardown times. Additional factors include mission data base distribution and incomplete environmental testing. Data communications meet the requirement.

The SCAMP is not operationally suitable for use in the tactical environment. The shortcomings in reliability and availability, as evidenced under operational test conditions, demonstrate that the system is not ready for unconditional fielding. However, during the LUTE, RAM performance was better than during FOT&E, and training and technical manuals improved.

RECOMMENDATIONS

The Program Office should continue aggressive action to correct the shortcomings in operational effectiveness and operational suitability.

SCAMP should not be approved for Full Materiel Release until its most significant effectiveness and suitability shortcomings are corrected. Fixes must be verified by operationally realistic testing. DOT&E agrees with ATEC’s support of a Conditional Materiel Release which stipulated: (1) SCAMP Block I is fielded only at Division Headquarters and above for general forces and at Group Headquarters and above for Special Operations Forces; and (2) the Tactics, Techniques and Procedures for operation of the overall system are included in a more comprehensive training program.

Further testing must be conducted to determine SCAMP's ability to operate under a full range of electromagnetic, tropic, and cold region environments.

SCAMP operations, in particular the process of loading a data base from the Communications Planner to the SCAMP device, may be too complicated to qualify it as a general-purpose user terminal. Experienced signal or operations personnel should be used in this process.

STINGER RMP

Army ACAT II Program

Total Number of Systems (FY01PB):	13,445 (RMP Block I)	
Total Program Cost (TY$):	$350.615M	
Average Unit Cost (TY$):	$26,077	
Full-rate production:	3QFY94 (RMP Block I)	

Prime Contractor
Raytheon

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Stinger missile is the Army's system for short-range air defense. It provides the ground maneuver commander with force protection against low-altitude airborne targets, such as fixed-wing aircraft, helicopters, unmanned aerial vehicles, and cruise missiles. The Stinger is launched from a number of platforms: Bradley Linebacker, Avenger on High Mobility Multi-Purpose Wheeled Vehicle (HMMWV), and helicopters, as well as the Man-Portable Air Defense (MANPAD) configurations.

There were two upgrades planned for the Stinger-Reprogrammable MicroProcessor (RMP) missile to correct known operational deficiencies of the original Stinger-RMP missile system. The first upgrade, called Stinger-RMP Block I, made software and hardware changes, including a new roll frequency sensor, a small battery, and an improved computer processor and memory. It is currently in the Army and Marine Corps inventory. The second upgrade, Stinger-RMP Block II, was intended to improve both hardware and software, including an advanced imaging focal plane array and additional signal processing software. The Stinger-RMP Block II missile was intended to provide improved performance against targets in clutter, more advanced stealthy cruise missiles, UAVs, and suppressed helicopter targets, and improved performance during nighttime operations.

The Stinger RMP Block II would contribute to ***Joint Vision 2020*** as a tactical ***precision engagement*** system that enhances the Army's ***dominant maneuver*** capabilities in the ground battle. Its strong capability against threat aircraft contributes to ***full dimensional protection***.

BACKGROUND INFORMATION

Operational deficiencies were discovered during testing of the Stinger-RMP missile in the late 1980s. The Secretary of Defense directed the Army to correct the deficiencies and then operationally test the fixes. In the 1990 TEMP, DOT&E approved a proposed operational test consisting of 24 missile firings.

The Stinger-RMP missile test program was suspended during Operation Desert Storm, and the missile was rushed into the field in preparation for war. After the Gulf War, the Army proposed a two-phase upgrade program: Stinger-RMP Block I and Stinger-RMP Block II. The Stinger-RMP Block I missile consisted of hardware and software modifications designed to solve some of the operational deficiencies observed during testing. The Stinger-RMP Block II consists of additional hardware and software modifications designed to resolve the remaining deficiencies. The major improvement in the Stinger-RMP Block II missile was the addition of a focal plane array IR seeker. Subsequently, the Army conducted tests on the Stinger Block I without an OSD-approved TEMP. This TEMP that would have supported these events was not approved by OSD because the planned testing had been considered to be not operationally realistic. Fifteen test firings were conducted between 1993 and 1996 to verify Stinger-RMP Block I hardware and software improvements. DOT&E's conclusions from the results of these tests include the following:

1. The firings did not resemble OT&E-like firings or soldier training exercises.
2. Most of the firings were off of a mount and not conducted with soldiers.
3. All firings were conducted after a countdown so that the engagement parameters (range, target behavior, clutter, missile tracking) were pre-determined.
4. The firings were predominantly in the lower half of the engagement envelope and the first long-range firing missed.
5. There were no firings against multiple targets and maneuvering targets.
6. There were few firings against low IR signature targets, such as UAVs.
7. There was only one firing at night.
8. The Block I test firing program did not contain the conditions under which the Stinger missile is expected to operate.

In 1999, the Army concentrated on preparing the Stinger-RMP Block II program for a Milestone II decision in 1QFY00; DOT&E worked with the Army on developing a test strategy. The activities accomplished included the approval of an updated Operational Requirement Document, an updated System Threat Assessment Report, and new Critical Operational Issues. The Test and Evaluation Master Plan (TEMP), approved by OSD in October 1999, describes the strategy for developmental testing, combined operational and developmental testing, Live Fire Testing, Modeling and Simulation, and IOT&E that was planned to be conducted in 4QFY05.

The Army had proposed to field more than 13,000 Stinger-RMP Block I missiles. These missiles will remain in inventory until at least 2020. There were also plans to produce approximately 11,000 Stinger-RMP Block II missiles. The Army cancelled the Stinger-RMP Block II missile program in early FY00. Recent Foreign Military Sales added $32.4 million in RDT&E and $91.9 million in Procurement for 1627 retrofits.

As a separate but related issue, Congress has urged the Army to evaluate the Air-to-Air advantages and disadvantages that Stinger RMP Block I and the British Starstreak missiles provide for the Longbow Apache (AH-64D). This comparative analysis will include live Stinger and Starstreak shots off the Apache helicopter.

TEST AND EVALUATION ACTIVITY

The preparation of the Stinger RMP Block II TEMP, approved by OSD in October 1999, was the only T&E activity of significance to have occurred in FY00. The following top five concerns, from an operational evaluator's view, were addressed in the TEMP:

1. The lack of Tactics, Techniques, and Procedures for effectively operating the Stinger-RMP Block II missile system. This concern is predicated on modifications made to take advantage of improvements in the seeker's ability to detect, track, and engage targets beyond-visual range.
2. The probability of fratricide and out-of-range engagements, which increased because of the Block II missile seeker's extended acquisition range (beyond the missile's range of approximately 5000 meters).
3. The software algorithms for performance in a countermeasure environment.
4. The lack of threats defined for the system. Consequently, few tactics and doctrine have been developed for employing the missile on helicopters, although there is a requirement for the Stinger-RMP Block II missile to operate from helicopters.
5. Lack of plans calling for use of Modeling and Simulation for test and evaluation. Considerable work in model development remains to be done.

Subsequently, the Stinger RMP Block II was cancelled.

Planning for the Stinger/Starstreak tests continues. DOT&E intends to oversee the test and report the results.

TEST AND EVALUATION ASSESSMENT

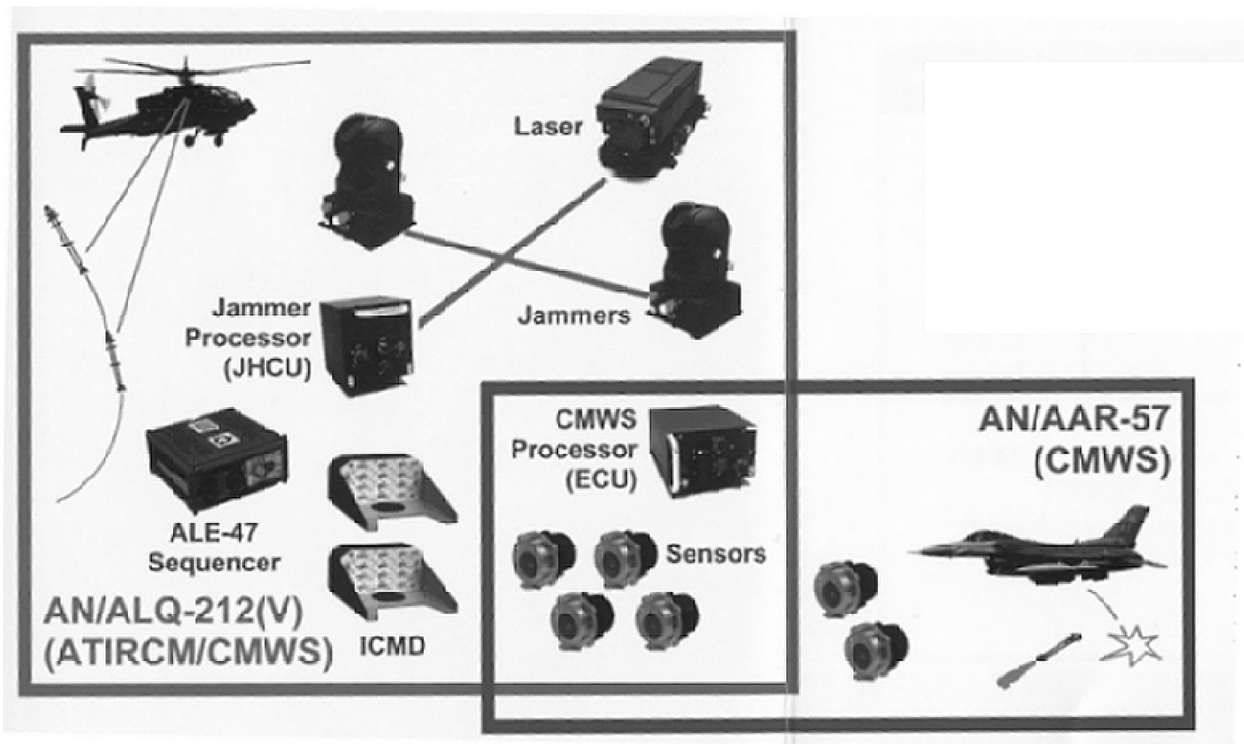
DOT&E believes that the Stinger-RMP Block I missile was not adequately tested despite the fact that the missile is currently fielded to Army units. The Stinger-RMP Block I program did not have an OSD-approved test strategy because the proposed test program was not operationally realistic. Thus, hardware and software modifications made to the Block I missile to resolve known operational deficiencies were not adequately tested.

Consequently, because the Stinger-RMP Block II missile system was cancelled, significant operational shortfalls with this system may remain in the Army's ability to conduct short-range air defense. In particular, there will be a limited operational capability to defeat the growing threat of UAVs and cruise missiles. Furthermore, limitations will remain against helicopters and fixed-wing aircraft that have more sophisticated countermeasures or operate in clutter. Finally, there may be a diminished effectiveness of the forces equipped with Stinger missiles during nighttime operations.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

The Army's short-range air defense units are fielded with Stinger missiles that have never been operationally tested. This leads to the following conclusions: (1) the operational effectiveness and suitability of those units cannot be assured; and (2) because the Stinger-RMP Block II missile was cancelled, possible deficiencies in the Army's efforts to defeat the evolving threat of UAVs, cruise missiles, and manned aircraft (with advanced countermeasures that operate in clutter) may remain. Since limited testing of the Stinger-RMP Block I was conducted at night, there may be deficiencies during nighttime operations. Additional night testing needs to be conducted.

SUITE OF INTEGRATED INFRARED COUNTERMEASURES AND COMMON MISSILE WARNING SYSTEM (CMWS, AN/AAR-57) (SIIRCM/CMWS) INCLUDES: ADVANCED THREAT INFRARED COUNTERMEASURES (ATIRCM, AN/ALQ-212)



Army ACAT IC Program		**Prime Contractor**
Total Number of Systems:	1,047	SANDERS, a Lockheed Martin Company
Total Program Cost (TY$):	$3,117.2M	**Major Subcontractor (CMWS-sensors)**
Average Unit Cost (TY$):		Lockheed Martin Infrared Imaging Systems
ATIRCM B-KIT:	$2.7M	**Group A Contractors**
CMWS B-KIT:	$1.6M	Boeing, Lockheed Martin Tactical Aircraft
Full-rate production:	2QFY03	Systems, Northrop Grumman

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Suite of Integrated Infrared Countermeasures (SIIRCM)/Common Missile Warning System (CMWS) contributes to the ***Joint Vision 2020*** concept of ***full spectrum dominance*** by improving individual aircraft's (or ground vehicle's) probability of survival against an increasing worldwide proliferation of advanced infrared (IR) guided missiles. This will provide aircraft and offensive ground vehicles added capability to achieve ***dominant maneuver*** and ***precision engagement*** over enemy forces.

The Advanced Threat Infrared Countermeasures (ATIRCM) is part of the U.S. Army's SIIRCM concept of IR protection including new IR flare decoys, the Advanced Infrared Countermeasures

Munitions, and passive IR features. These passive IR features include host platform modifications such as engine exhaust/heat suppression and special coatings intended to reduce the platform IR signature. ATIRCM is a sub-set of the SIIRCM program, and is specifically comprised of an active IR jammer for use on helicopters and the passive Common Missile Warning Receiver. Until this year, CMWS was to be used on both helicopters and fixed wing aircraft. However, funding constraints have led the Air Force to drop out of the program. Therefore, for the immediate future, the only application of ATIRCM/CMWS will be on Army helicopters.

The ATIRCM/CMWS design is modular to allow multiple configurations on a wide range of aircraft and other vehicles. The Army's lead platform for EMD are the MH-60K and the EH-60. Previously, the AV-8B and the F-16 Block 40-Close Air Support aircraft were the lead aircraft for the Navy and Air Force, respectively. Two ATIRCM laser jam heads are the normal configuration for most helicopters and transport aircraft, though only one ATIRCM jam head is now currently planned for tactical helicopters. CMWS is a software re-programmable system intended to provide automatic passive missile detection, threat declaration, positive warning of a post-launch missile that is homing on the host platform, countermeasures effectiveness assessment, false alarm suppression, and cues to other on-board systems such as expendable countermeasures dispensers. For the helicopter applications, the ATIRCM adds active directional countermeasures via an arc lamp and laser. ATIRCM is required to demonstrate integration with the Army's Suite of Integrated Radio Frequency Countermeasures.

BACKGROUND INFORMATION

The SIIRCM/CMWS is a Joint Service, Army lead program. In January 1995, USD (AL&T) approved the merger of the Army ATIRCM program with the Navy/Air Force Advanced Missile Warning System program. The program entered EMD in September 1995. The IPT formed in June 1995, and produced a TEMP, which was approved by OSD in April 1996. After expanding the EMD Critical Design Review process, experiencing delays in initial EMD hardware/software production, and adjusting detailed T&E planning, the Acquisition Program Baseline schedule was approved in June 1997, moving the MS III objective/threshold from February-August 2000 to March-September 2001. Additional developmental delays have changed the MS III date to 2QFY03. A Limited Rate of Initial Production (LRIP) decision in April 2002 has been added to the program. An Operational Assessment, to be conducted in early 2002, is designed to provide data to support the LRIP decision. The Operational Requirements Document was changed in FY97 to include a more realistic threshold-to-objective range for ATIRCM effectiveness.

The Joint Project Office (JPO) was relocated from ST Louis, MO to Huntsville, AL, during 4QFY97, as part of a Base Realignment and Closure move of the Army Aviation Electronic Combat Project Office. Since the relocation, the JPO has been established and staffed as a separate Project Managers Office directly under PEO Aviation.

In FY98, an Integrated Product Team developed a fully coordinated TEMP update to maintain adequate T&E concepts/resources by accepting additional program schedule risk. T&E funding for the program has been reduced to free funding for other program cost growth and to keep the program executable within available funding levels. DOT&E approved a TEMP update in November 1998.

Fiscal Year 1999 test activity was mostly centered on Test and Measurement (T&M). T&M efforts have continued to gather both instrumented ground truth and prototype sensor views of environmental, threat, and false alarm data. T&M collection events planned during the year slipped to the end of FY99 due to CMWS sensor availability, Operational Flight Profile (OFP) development difficulties, and cost of the T&M effort.

TEST & EVALUATION ACTIVITY

Many of the hardware and software problems experienced earlier were partially resolved in late FY99, allowing the contractor to conduct extensive environmental qualification tests early in FY00. Some vibration related problems have been experienced in these tests, especially with the IR jammer, but the system performed well enough to install it on both the MH-60 and EH-60 helicopters. A series of contractor flight tests have been conducted this year to assess false alarm performance and to test jammer effectiveness against ground mounted missile seekers. Contractor testing will continue into late FY00, to include sled tests at Holloman AFB and some additional contractor flight tests at Ft. Rucker, AL. Upon successful completion of these tests, ATIRM/CMWS will enter into government development testing in early FY01.

Some multi-spectral test and evaluation limitations can only be overcome through iterative (i.e., model, test, model) M&S in conjunction with DT/OT events that construct and validate an end-to-end OPEVAL environment. Use of digital M&S in conjunction with a Hardware-In-The-Loop (HITL) modeling will be the primary way to perform an end-to-end test of the system. Supporting system development and some aspects of the M&S effort are dependent on the prime contractor's system design process and hardware deliveries. The approved TEMP T&E concept for the CMWS included HITL testing that was under development at AFEWES, Ft. Worth, TX. Project Office development of the HITL began in December 1998, with a Proof of Concept (POC) demonstration conducted in March and October 1999. Use of a dome HITL for the end-to-end testing of IR/UV missile warning sensors has not been done before and presents several technical challenges. Data from the POC's have revealed that the technology is not sufficiently mature to proceed with AFEWES development. An alternative hardware in the loop capability is being developed at the contractor's plant to support the program's T&E strategy for CMWS testing and validate IR threats in a multi-spectral threat environment.

Hardware-in-the-Loop modeling capabilities are essential to providing an assessment of the operational effectiveness and operational suitability of the ATIRCM/CMWS system. Actual missile firings and drone target requirements have been reduced from nearly 400 to 175 events by developing new T&E concepts that rely heavily on M&S. Without a properly validated and verified HITL, DOT&E does not believe the M&S methodologies developed by the Project Office will be credible.

In March 1999, ATIRCM/CMWS sensor and jam head laser production difficulties, OFP development delays, and other EMD issues resulted in a cost and schedule breach and subsequent re-baselining of the program. The Project Office's primary efforts during FY99 were the restructuring of the program, though T&E resourcing and M&S development efforts continued. M&S efforts and software development showed good progress as evidenced by implementation of software engineering control standards and incremental M&S software development. Progress has also been made towards integrating M&S into the Systems Integration Laboratories (SIL) (located at the contractor's plant and several government facilities). Nearly all T&E test assets have been procured, with scheduled test activity awaiting contractor delivery and government acceptance testing of system components. The new schedule allows: (1) the Project Office to solve EMD delays; (2) delivery of a more robust Operational Flight Profile (OFP) for M&S with HITL; and (3) more coordinated DT/OT testing.

TEST & EVALUATION ASSESSMENT

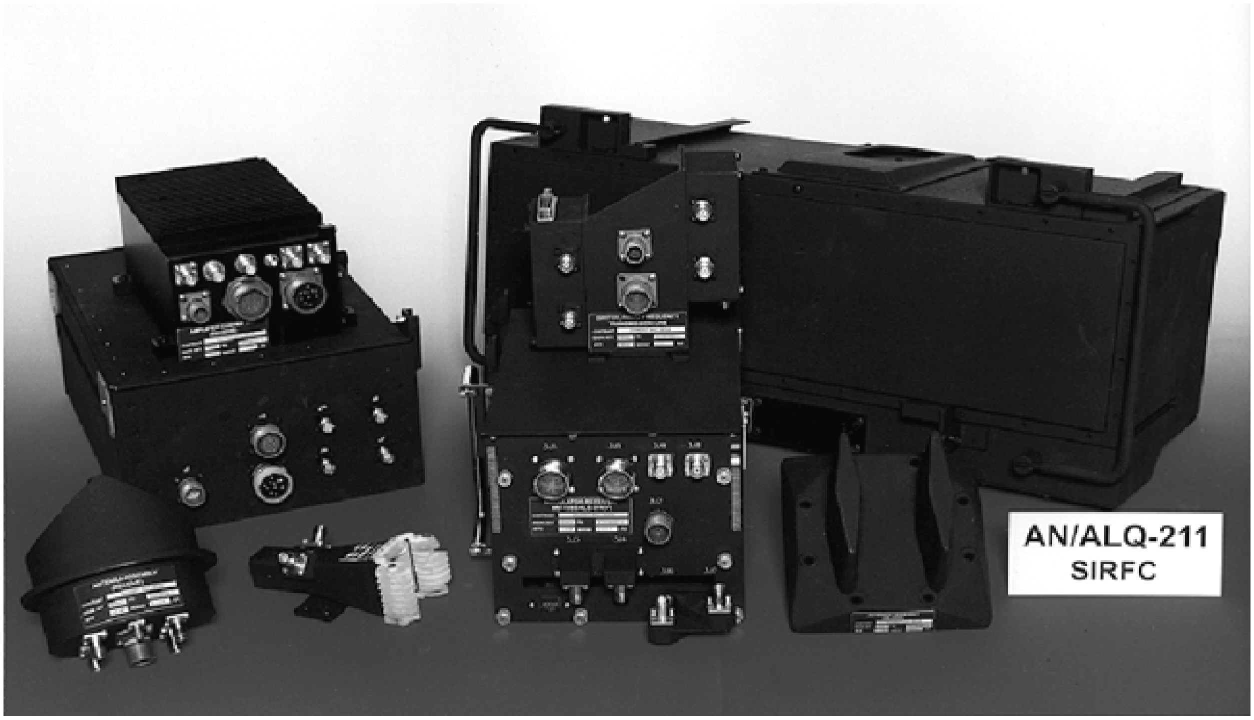
It is highly unlikely that the program can deliver the required performance within its current budget and schedule. What is being attempted in this program is technologically hard to do and may not work. This program will need robust and rigorous testing to illuminate the technical challenges. This program is organizationally difficult to manage because of its multi-Service character and the fact that it is a sub-system supporting other programs, which results in inconsistent funding, interest, and support. And finally, the test program is heavily dependent on an end-to-end modeling and simulation process that has yet to be Verified, Validated, and Accredited (VV&A). The VV&A requirement is a significant challenge. There are no doubt unknown challenges to be discovered; yet the entire T&E schedule is success oriented due in large part to past delays in the program. As a result, there is little time allocated for problem correction. In October 1998, the JPO identified funding shortfalls that would adversely impact delivery of required EMD components to support DT. Delays in completing the system design and initial EMD hardware deliveries resulted in subsequent delays in completing T&E related events. Most notably this has contributed to delays in the development of system OFP software required to complete challenging modeling and simulation activities.

Modeling and simulation are critical elements of the test and evaluation program because the matrix of potential missile-aircraft interactions to be evaluated would require a substantial increase in the number of test firings. M&S will be used to examine many of those interactions while simultaneously reducing program costs. However, the FY99 slip in the program schedule, caused by continued EMD hardware development difficulties, has adversely impacted software deliveries essential to the M&S effort. The aggressive continuum of M&S intended to support development, hardware (and software) in the loop testing, open air range testing, installed equipment testing, and IOT&E of the system is dependent upon timely delivery of OFP and system hardware. The contractor has made progress during the past year in software and hardware development and testing; however, continued delays in contractor-furnished EMD hardware/software delayed completion of contractor ground and flight tests until 1QFY01.

Delayed EMD deliveries have resulted in an Air Force decision to drop out of the program. The Air Force will, however, assist the Army in conducting fixed-wing (QF-4) tests that are crucial to obtaining data for the M&S program, and to provide data to evaluate CMWS performance on high speed, fixed-wing platforms in the event the Air Force and/or the Navy decide to use CMWS in the future. Some of the Air Force funding allocated for fixed-wing testing will be used to conduct the drone tests. Additional program schedule risk accepted by the Project Office in the current TEMP is attributable to a reduction in available T&E resources (QF-4 drone targets, test instrumentation packages, spare threat missiles, and missile telemetry kits, etc.) to absolutely bare minimums. Mitigating features of the test design and M&S efforts are intended to help control scarce test resources. Again, the program's schedule contains little allowance for developmental delays. If expenditure of EMD resources exceeds the rates anticipated, system integration efforts are delayed, or fixed wing T&E funding is not retained in the program, the test program will be forced to halt pending: (1) identification of the EMD integration and test problems; (2) procurement of additional funding sources; and (3) time required for the procurement and build-up of replacement test resources to complete the minimum adequate IOT&E identified in the TEMP. To reduce risk and cost, the multi-Service Test Team proposed a test strategy that utilized the Aerial Cable Facility (ACF) at the White Sands Missile Range for all rotary-wing live missile-firing events. DOT&E approved the test strategy, and further believes that use of the ACF is central to an adequate and suitable test program. A System Assessment, based on all credible data collected through the end of Integrated DT/OT sled testing, will be provided to support the LRIP decision. A dedicated OT in support of the MS III decision will follow the Integrated DT/OT, and will focus primarily on M&S and on data collection concerning supportability, Potential False Alarm Sources, and pilot usability aspects of system performance as the aircraft is exposed to maneuvers expected on the modern battlefield.

The operational configuration for tactical helicopters calls for only one ATIRCM jam head on top of the platform behind the rotor (two jam heads are to be used for transports and large helicopters). DOT&E is concerned that the single jam head configuration for tactical rotary-wing aircraft may not ensure adequate defensive protection when the single jam head is masked by the aircraft fuselage during tactical employment of host platforms. The operational consequences of a single jam head needs to be examined to ensure adequate defensive protection exists when the single jam head is masked by the aircraft fuselage during tactical employment of host platforms.

SUITE OF INTEGRATED RADIO FREQUENCY COUNTERMEASURES (SIRFC) AN/ALQ-211 (V)



Army ACAT III Program

Total Number of Systems:	465
Total Program Cost (TY$):	$1,035M
Average Unit Cost (TY$):	$1,500K
Full-rate production:	2QFY03

Prime Contractor

ITT Avionics Division-Clifton, NJ

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Suite of Integrated Radio Frequency Countermeasures (SIRFC) contributes to the ***Joint Vision 2020*** concept of ***full-dimensional protection*** by improving the individual aircraft's probability of survival. In addition, the improved aircrew situational awareness offered by the synergistic effect of SIRFC, with other attack aircraft sensors, has the potential to contribute tactically to ***precision engagement***, and could also contribute tactically to ***dominant maneuver***. SIRFC is intended to be an integrated aircraft survivability system that provides defensive, offensive, active, and passive countermeasures to ensure optimum protection for the host aircraft. There are plans for this system to be integrated on the AH-64D, MH-60K, and MH-47E helicopters, and the CV-22 and U-2 fixed-wing platforms. The lead aircraft for SIRFC integration and test and evaluation has transitioned from the AH-64D Longbow Apache to the CV-22. Subsequent host aircraft platforms desiring SIRFC will undergo FOT&E to assess unique platform integration effectiveness and suitability issues. SIRFC consists of two required sub-systems: the Advanced Threat Radar Jammer (ATRJ), and the Advanced Threat Radar Warning Receiver (ATRWR). The Advanced Airborne Radio Frequency Expendables package and the Escort Stand-Off variant are two system optional components that are currently unfunded. The basic system will be capable of operating in either an automatic or manual (command) mode. It provides warning (situational awareness), active jamming (self-protection), and when necessary, expendable countermeasures to defeat threat radar guided weapon systems. Radar guided air defense artillery threat systems include surface-to-air missiles and anti-aircraft artillery. A Southwest Asia theater of operations set in 2006 is the basis for threat selection for the EMD program. Threat systems are not only those originating from within the Former Soviet Union, but also systems made and proliferated by the United States, our allies, and other weapons producers. Future integration of SIRFC with the Suite of Integrated Infrared Counter Measures on aircraft, which may be equipped with both systems, is a program objective that optimizes multi-spectral threat countermeasures.

BACKGROUND INFORMATION

From this point on, when the name SIRFC is used, it will refer specifically to ATRJ and ATRWR, which are major sub-systems under this program's development. SIRFC entered Milestone I in FY90, and two prototype systems were delivered in FY93. In addition to Hardware-in-the-Loop (bench) testing, DEM/VAL testing was conducted at Eglin AFB in an EH-60 aircraft beginning in FY93. SIRFC entered Milestone II in 1QFY95, with an EMD contract to produce five test articles supporting T&E through IOT&E. The initial lead aircraft for SIRFC integration and testing was the AH-64D Longbow/Apache. The Army reduced the priority of the Apache requirement for SIRFC, eliminating SIRFC production funding from the Apache budget and, more recently, transitioning lead test platform responsibilities over to CV-22. The program underwent an acquisition plan restructure in FY00 to allow for correction of problems discovered in early testing and to better accommodate program milestones and execution of allocated program funding. MS III is scheduled for January 2003.

TEST & EVALUATION ACTIVITY

The first EMD test articles were delivered in 3QFY99, and installed on the AH-64D Longbow Apache for integration testing. Some of the initial "box-level" tests conducted prior to platform integration included: safety of flight qualification, electromagnetic compatibility, initial software validation, maintenance logistic demonstrations, environmental qualification, bench performance, direction finding accuracy, modulator-receiver characterization, antenna pattern, and pole testing. Upon SIRFC installation on the AH-64D Apache, the test team encountered several integration performance problems with the Operational Flight Program (OFP) software. The most recent of these problems surfaced during 1QFY00 developmental testing at the Bennefield Anechoic Facility (BAF) at Edwards AFB, CA. The purpose of BAF testing was to evaluate SIRFC's integrated system performance as installed on the test platform. Aircraft platform testing at BAF included threat identification and prioritization, evaluation of deployment of jamming techniques, performance against both single and multiple emitters (system loading), and measurement of Angle of Arrival accuracy. During this testing, the SIRFC system revealed significant performance problems handling threat emitters in a dense signal environment. These problems have led the Program Manager to stop current test efforts on the AH-64D until integrated performance issues have been resolved. An additional year has been inserted into the EMD Phase. This should allow time in the EMD schedule to sufficiently analyze discovered deficiencies, develop and implement corrections, and properly evaluate OFP software performance. Initial reports on the results of this effort have been positive. The added time will also allow the developmental test team to incorporate more stress testing throughout the validation and verification of the software.

The Program's early test schedules revealed very limited time for the "Test-Analyze-Fix-Re-test" process to occur during Developmental Testing. The proposed additional one-year that would be inserted into the restructured EMD phase should allow adequate time to evaluate development of the maturing software and hardware design. It will also allow for more effective utilization of test resources, which were a challenge in earlier EMD schedules.

TEST & EVALUATION ASSESSMENT

The risk of providing the expected operational performance within the current budget and schedule is medium, but improving. The major T&E challenges facing the program are tightness of the test schedule and timely definition of T&E organizational relationships associated with this joint program. The SIRFC Program Manager has concluded that the previously promulgated test and evaluation schedule did not allow for adequate time to resolve unknown technical problems commonly encountered during the development of electronic warfare programs. Initial SIRFC program schedules relied too heavily on the results of contractor testing prior to delivery to the government for independent validation and verification. Early reliance and confidence in contractor testing prompted the program management team to reduce the size and scope of independent government testing. Although "box-level" performance in the contractor's test facility was adequate in assessing performance in a controlled laboratory environment, it did not sufficiently evaluate system performance in a dynamic, multiple emitter environment that heavily tasks and stresses OFP software. The recent integration problems encountered during performance testing at BAF provided the necessary data to support the Program Managers' actions to restructure the EMD phase of the program to include more effective developmental testing. This restructuring shall allow adequate verification of system performance through a robust developmental test program and provide for sufficient time to address technical deficiencies.

In light of lead test platform changes, the second major T&E challenge facing the program at this point is the timely definition of the working relationship between the two Service OTAs, ATEC and AFOTEC. The CV-22, a Navy program being evaluated by AFOTEC, has replaced the AH-64D Longbow/Apache as the SIRFC lead test platform. ATEC, the SIRFC lead test agency, now plans to evaluate SIRFC performance against its COIs for the MS III decision using information collected by AFOTEC during CV-22 IOT&E. The details of the working relationship between ATEC and AFOTEC are being coordinated so that the CV-22 test program provides ATEC the needed information to evaluate SIRFC performance against its COIs for the MS III decision.

DOT&E will continue to remain engaged in the formulation and execution of the restructured EMD phase of the program and monitor the developing OTA relationships.

TRANSPORTATION COORDINATORS' AUTOMATED INFORMATION FOR MOVEMENTS SYSTEM II (TC-AIMS II)

<u>Army ACAT IAM Program</u>		**<u>Prime Contractor</u>**
Total Number of Systems:	7,300 sites 17,600 users	DynCorp
Total Program Cost (TY$):	TBD	
Average Unit Cost (TY$):	TBD	
Full-rate production:	TBD	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Transportation Coordinators' Automated Information for Movement System II (TC-AIMS II) addresses critical shortfalls in the movement of materiel and personnel in support of DoD operations. It merges the best business practices of the current Service-unique transportation automated information systems into a single system that combines the requirements for the Unit Movement, Installation Transportation Office/Transportation Management Office, and Theater Distribution functional areas, and integrates the following legacy systems:

Unit Movement Functional Area:

U.S. Marine Corps:

- Marine Air Ground Task Force Deployment Support System II.
- Transportation Coordinators' Automated Information Management System.

U.S. Army:

- Rail Load Planning module from the Transportation Coordinator Automated Command and Control Information System.

- Convoy module from the Department of the Army Movement Management System–Re-design.

Installation Transportation Office/Transportation Management Office Functional Area:

U.S. Air Force:

- Cargo Movement Operations System.

At full operational capability, TC-AIMS II will provide an integrated transportation information system capability for routine deployment, sustainment, and redeployment/retrograde operations. The system must be integrated with installation, unit, and depot-level supply systems to manage inbound and outbound movement documents and requisition information (less household goods). TC-AIMS II will automate installation shipping/receiving and deployment, sustainment and re-deployment/retrograde processes; produce movement documentation; and furnish timely information to the Service major subordinate commands, United States Transportation Command, transportation component commands, and the joint deployment community, and will also support warfighters at the unit level. As a DoD source movement information system, it will provide in-transit visibility and control over cargo and passenger movement. TC-AIMS II supports the ***Joint Vision 2020*** concept of ***dominant maneuver*** by improving joint capabilities for rapid worldwide deployment and reducing "buildup time." It supports the ***Joint Vision 2020*** concept of ***focused logistics*** by enabling rapid crisis response at unit and installation transportation offices. TC-AIMS II allows the direct delivery of tailored logistics and sustainment packages at the strategic, operational, and tactical level of operations.

BACKGROUND INFORMATION

In 1987, the Secretary of Defense directed that programs be initiated to provide automated support to Service transportation coordinators. Joint Staff Memorandum (JSM) 3-87 directed the Services to implement this guidance. Each Service developed its own system to comply with JSM 3-87. In 1993, the Secretary of Defense directed that improvement actions be taken to increase standardization, improve processes, and migrate multiple parallel and/or stovepipe systems into effective multi-purpose, multi-Service automated support systems. In March 1995, the Office of the Secretary of Defense approved the recommendations from the Joint Transportation Corporate Information Management Center to migrate selected portions of Unit Move and Installation Transportation Office/Traffic Management Office systems into an improved TC-AIMS II. TC-AIMS II was designated to be a standard joint system sufficiently flexible to meet Service-unique requirements. This system will be developed and fielded in functional blocks. The Joint Requirements Oversight Council approved the Operational Requirements Document in March 1999. However, TC-AIMS II does not yet have an approved Acquisition Program Baseline.

During joint exercise Foal Eagle 99, a prototype of TC-AIMS II was used to manage the deployment equipment list, create military shipping labels, and utilize advanced identification techniques to facilitate in-transit visibility during deployment and redeployment of the U.S. Marine Corps 31 Marine Expeditionary Unit and U.S. Army 2nd Brigade, 4th Infantry Division. ATEC, the independent OTA, conducted an OA during the exercise. The results were not encouraging. The software was immature and had not undergone adequate DT. Experienced and enthusiastic Marines in Okinawa were innovative in trying to use the new system, but they were unable to make it work effectively. During the exercise, both the Army and Marine units were forced to revert to their respective legacy systems.

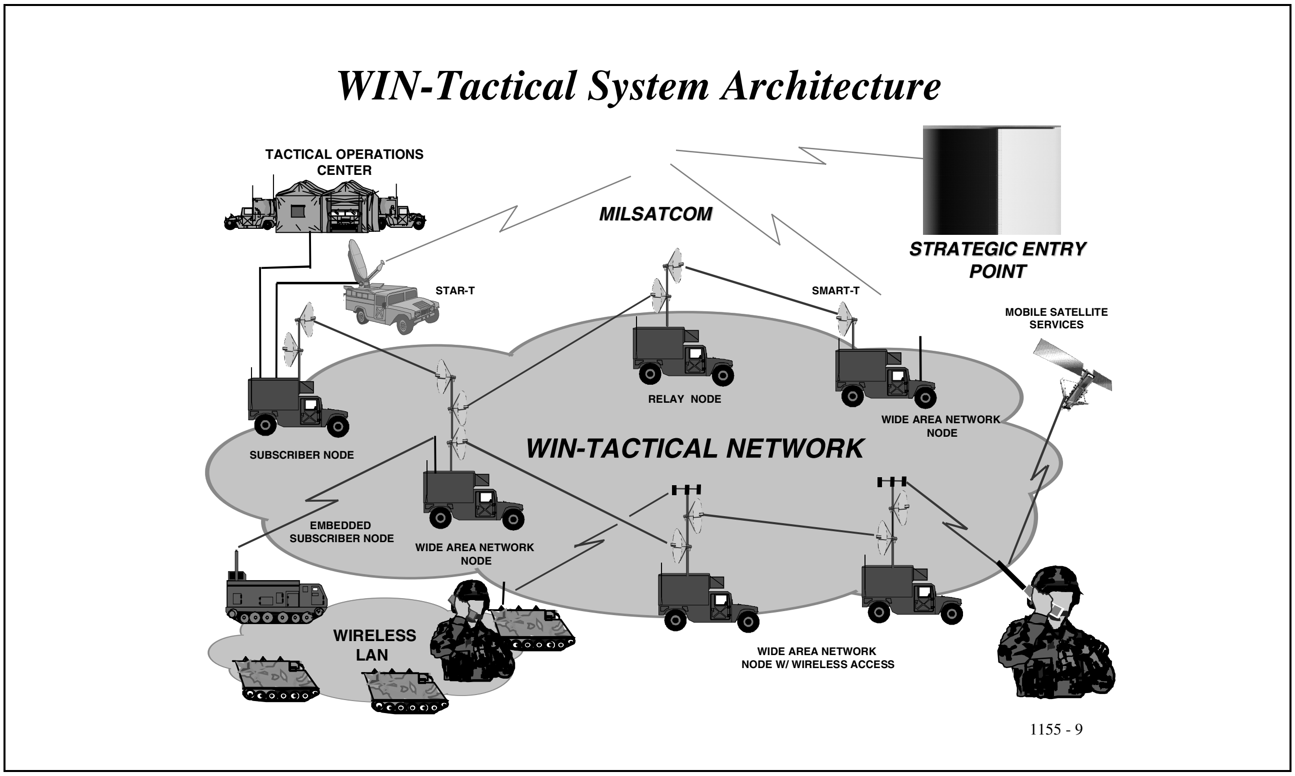
TEST & EVALUATION ACTIVITY

During 3QFY00, Software Qualification Testing was conducted. In late June 2000, the Configuration Management Board approved a change from the scheduled OT of the Unit Movement functionality (Version 3.01) to a Customer Test. This action was necessary due to 32 unresolved Priority 1 and 2 Problem Change Requests identified from the Software Qualification Test. ATEC conducted the Customer Test from July 19-August 30, 2000, at four Service test sites: Ft. Hood, TX; Shaw AFB, SC; Gulfport, MS; and Camp LeJeune, NC. The results showed that none of the Services were able to complete a transportation planning, coordination, and execution scenario from end to end. It was apparent that significant development efforts remain. The IOT&E for Version 3.01 is currently planned for 2QFY02.

TEST & EVALUATION ASSESSMENT

For the first time, a single system is being developed to integrate the transportation and movement control systems/procedures for all four Services. However, before the processes can be automated successfully, the procedures must be jointly agreed upon and standardized. This has presented a substantial institutional challenge in the past, but progress is being made. As TC-AIMS II continues development, its numerous external system interfaces will present significant technical and operational challenges.

WARFIGHTER INFORMATION NETWORK – TACTICAL (WIN-T)



Army ACAT ID Program

Total Number of Battalion Sets:	63
Total Program Cost (TY$):	$3B (est.)
Average Unit Cost (TY$):	$50M (est.)
Full-rate production:	2QFY04

Prime Contractor

Source Selection 2QFY01

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Warfighter Information Network–Tactical (WIN-T) will be the Army’s tactical Intranet from theater and the sustaining base to the maneuver battalions in the field. WIN-T will be the communications network of the future and will replace aging Tri-Services Tactical Communications and Mobile Subscriber Equipment. The major WIN-T elements are network infrastructure, network management, information assurance, and user interfaces that provide voice, data, and video services. The network infrastructure consists of integrated switching, routing, and transport capabilities. The four major WIN-T elements, when integrated with the Army’s Tactical Internet, form the Army’s Tactical Intranet. WIN-T will enhance network management capabilities currently provided by the Integrated System Control and build on/incorporate these capabilities as the objective WIN-T architecture matures.

WIN-T will provide wired and wireless communications for voice, data, and video by relying on commercial products and technologies as available. WIN-T will support multiple security levels from Unclassified to Top Secret/SCI. It will operate in the tactical environment and be mobile, secure, and survivable. It will integrate terrestrial, airborne, and satellite-based transport capabilities into a network infrastructure to provide connectivity across the extended battlespace. WIN-T capabilities supporting the user will be integrated into maneuver platforms and deployed with the Warfighter. Network management and Wide Area Network coverage capabilities will be deployed by Signal Units to enable the Warfighter freedom of maneuver across larger areas of operation with greater dispersion of forces.

WIN-T is an enabler to gaining ***information superiority,*** and will integrate legacy and future battlespace networks into the Army's Intranet. The Army's Intranet is intended to meet the operational requirement for leaders to visualize, understand, coordinate, collaborate, and execute across the battlespace in order to bring their patterns of operation, as described in ***Joint Vision 2020,*** to a focused conclusion. In total, WIN-T's Intranet will provide the warfighter enhanced control over his battlespace, enabling him to personally influence the actions of peers, subordinates, and allies as he adapts his scheme of maneuver to defeat the adversary.

BACKGROUND INFORMATION

WIN architecture was approved in January 1996, and the first draft Operational Requirements Document was approved by the Signal Center in April 1998. The WIN-T acquisition strategy was implemented in July 1998. Draft statements of work and developmental specifications were developed in October 1998. The WIN-T program was placed on the Pre-Major Defense Acquisition Program list in November 1998. In early 1999, the program office began OSD briefs, and IPT meetings commenced in May 1999. As a result of changes to the Program Objective Memorandum, a more extensive research and development effort, starting with a risk-reduction phase, will be planned.

TEST & EVALUATION ACTIVITY

Due to changes in the Program Objective Memorandum, all T&E activities were deferred during this reporting period. Although the Operational Requirements Document and the Critical Operational Issues and Criteria are still in draft form, operational test and evaluation strategies for the risk-reduction phase are in development and intended to be formalized in FY01. Initial Operational Test and Evaluation is being planned for 4QFY03, and is expected to test a battalion set of equipment in a division-sized operational test. A Product Assurance technical test is planned to precede IOT&E by one year, and will be conducted on a sub-set of the same production representative hardware used in IOT&E.

TEST & EVALUATION ASSESSMENT

No technical or operational testing has occurred. Operational test strategies are currently being developed for a division-sized network, with appropriate operational stresses to determine if WIN-T communications assets can support a deployed division. The intervening year between technical testing and operational testing is well advised to correct any identified problems prior to training of the operational test unit.

WOLVERINE

Army ACAT II Program

Total Number of Systems:	465
Total Program Cost (TY$):	$2,640M
Average Unit Cost (TY$):	$5.7M
Full-rate production:	4QFY00

Prime Contractor
General Dynamics Land Systems

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Wolverine provides assault bridging support for forward, heavy-maneuver forces, thereby utilizing the ***Army's Vision 2020*** concept of ***decisive operations***. The Wolverine launcher is mounted on an M1A2 Abrams System Enhancement Program chassis and should be able to be operated by a two-man crew. The bridge is 26 meters long and can span gaps up to 24 meters. It will support a Military Load Class 70 vehicle (e.g., a fully loaded, 70 ton M1A2 tank) crossing at 16 kilometers per hour. The Wolverine crew launches the bridge from under armor in five minutes and can retrieve the bridge in less than ten minutes.

The Wolverine will increase maneuver force mobility by allowing units to transit such gaps as tank ditches, road craters, and partially damaged bridge sections. The current Armored Vehicle Launched Bridge (AVLB) only supports Abrams tank units crossing at reduced gap length (15 meters) and reduced crossing speed. The Wolverine was to replace the AVLB in selected engineer companies of mechanized battalions, armored cavalry regiments, and heavy brigades.

BACKGROUND INFORMATION

The Army's Acquisition Executive notified OSD that the Army designated the Wolverine program an ACAT II program and a covered system for LFT&E in a memorandum dated June 4, 1996. The June 1992 Milestone II decision pre-dated the designation of Wolverine as an ACAT II program. Wolverine was added to the FY97 Annual T&E Oversight List for LFT&E only.

DOT&E has participated in the Wolverine LFT&E Integrated Process Team since May 1996, and approved the completed strategy in March 1997. Dedicated LFT&E events began in 4QFY97 and continued through November 1999.

TEST & EVALUATION ACTIVITY

The approved Live Fire vulnerability testing strategy included three phases of testing: (1) ballistic testing against a deployed bridge; (2) full-up, system-level testing of a production representative bridge and an up-armored prototype launch mechanism mounted on an M1A1 chassis containing non-production-like Wolverine components; and (3) full-up, system-level testing of a production system. Phase I testing was successfully conducted during FY97, and Phase II testing was completed in FY98.

Fiscal Year 1999 and initial FY00 activities focused on planning for the Phase III test of a production-representative Wolverine began in 1QFY00. The Phase III test was to include both a controlled damage test and a five shot full-up, system-level ballistic vulnerability test. Planned ballistic threats to be fired included direct-fire HE, artillery, and hand-held infantry weapons. DOT&E approved the Phase III evaluation plan, participated in the shot-selection process, and approved the test plan prior to test execution.

In December 1999, the Wolverine program was included among several Army programs designated for termination due to changing priorities and a need to fund the Army's transformation. Following the termination decision, LFT&E activities were halted after having completed only two (and least damaging) of the five planned full-up, system-level live fire tests at the Army's Aberdeen Test Center. The production-representative live fire test vehicle was repaired by January 2000, but later was damaged beyond repair during user tests at Ft. Hood, TX. No overall system vulnerability evaluation has been reported.

Although the Army did not fund the Wolverine in its program objective memorandum for FY02-FY07, the Army described the Wolverine as its top unfunded requirement. The Fiscal Year 2001 Defense Appropriations bill conference report directed the Army to obligate FY00 Wolverine procurement funds, and the Army awarded a $34.4 million contract for the production of ten Wolverine systems. It seems likely that the Army will obligate the $77 million, allocated in FY01, and may continue to make yearly awards without establishing or achieving more specific procurement goals.

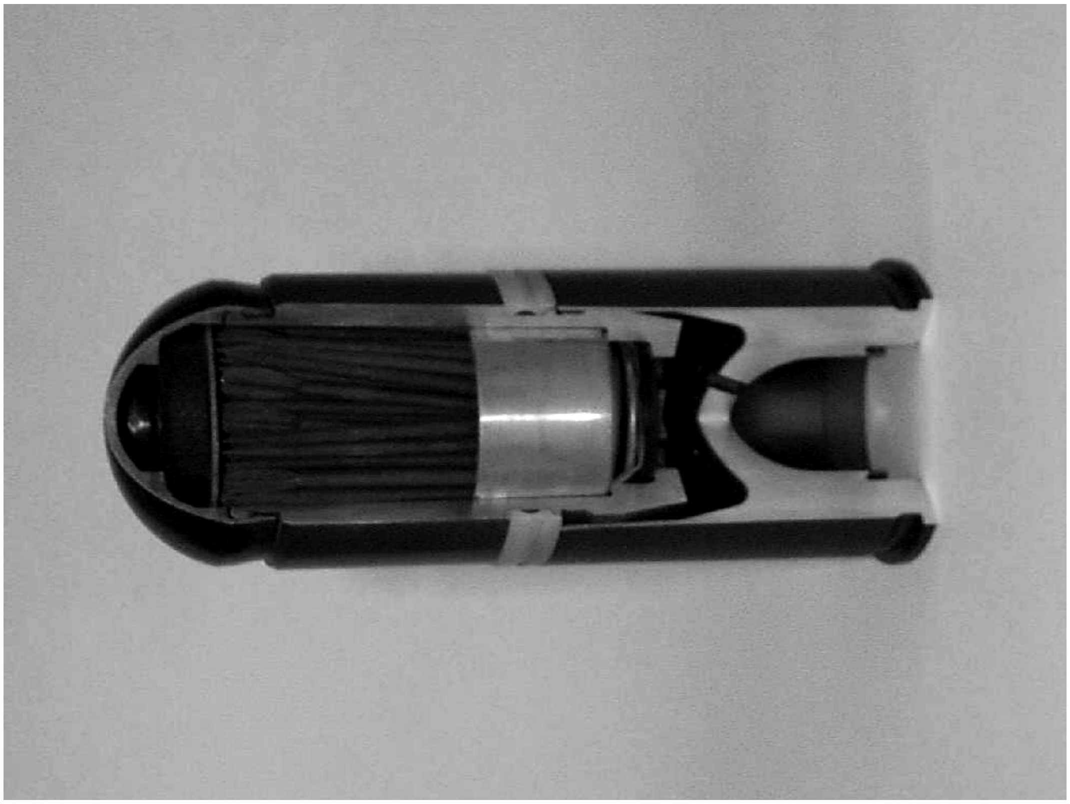
TEST & EVALUATION ASSESSMENT

Throughout Phase I and Phase II testing, the Wolverine bridge and launcher met or exceeded requirements. The bridge launching system continued to function when subjected to the blast and fragments of near-miss artillery rounds. The system completed its bridge-launching mission, and the deployed bridge proved capable of supporting a crossing of Military Load Class 70 vehicles per the requirement. The significance of vulnerabilities observed in initial Phase III tests were consistent with expectations, but would require further assessment to support an overall system evaluation.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

During the early planning stages of LFT&E, the program manager and the prime contractor recognized areas of potential weakness in the Wolverine system. Specific areas of concern included exposed hydraulic lines and cylinders, control sensors, and critical components located behind minimal armor protection. The contractor embarked on a program to resolve these areas of potential weakness prior to LFT&E. The fixes were simulated for Phase II and were in production prior to Phase III. If the continuing production of Wolverine warrants completion of the Live Fire vulnerability evaluation, the robustness of these fixes should be assessed.

XM1001 40MM CANISTER CARTRIDGE



Army ACAT III Program

Total Number of Rounds:	1M (approx.)	
Total Program Cost (TY$):	$200M	
Average Unit Cost (TY$):	$200 per round	
Full-rate production:	4QFY00	

Prime Contractor

Primex Technologies, Inc.

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The XM1001 will provide a short-range antipersonnel capability (from muzzle to 100 meters) for the Mk 19 Mod 3 Grenade Machine Gun. This cartridge is a flechette-dispensing grenade that will be used by combat forces as a force multiplier against ground troops in: (1) exposed positions; (2) extremely rugged terrain; (3) dense vegetation; (4) military operations in urban environment; and (5) other scenarios where the effectiveness and user-safety of the current Mk 19 family of ammunition is limited. This capability will support the ***Joint Vision 2020*** concept of ***dominant maneuver***.

This program was briefed to DOT&E as part of the Fourth Live Fire Test and Evaluation Oversight Review Conference for Small and Medium Caliber Ammunition held in December 1997. The total number of rounds produced is unknown at this time, but is estimated to be over one million. Hence, the Army nominated the XM1001 as a LFT&E program, and it was placed under DOT&E oversight in April 1998.

The XM1001 40MM grenade contains 113, two-inch long flechettes, with 13 of those packed within the grenade facing rearward. Upon exiting the muzzle of the Mk 19, an expulsion charge detonates, expelling the flechettes. Upon expulsion, the rearward facing flechettes rotate in-flight until they are forward facing.

BACKGROUND INFORMATION

This munition is part of the Soldier Enhancement Program (SEP), and funds were first identified for it in the June 1996 SEP review. The combined LFT&E Strategy/Event Design Plan was approved by DOT&E on November 2, 1998, and the Detailed Test Plan (DTP) was approved by DOT&E on July 30, 1999. DOT&E activity for this program involved LFT&E only.

LFT occurred during October-November 1999, and consisted of firings against mannequins in the open and with protection. Prior to LFT, in June 1999, 38 rounds were also fired at the Aberdeen Test Center for the purpose of better characterizing flechette velocity and dispersion as a function of range.

TEST & EVALUATION ACTIVITY

LFT was completed in 1QFY00. LFT&E activity during FY00 was focused on finalizing the DOT&E independent assessment report. DOT&E submitted this report to Congress in November 2000.

TEST & EVALUATION ASSESSMENT

An adequate lethality test program, comprising 112 shots against a variety of targets (i.e., personnel simulants in the open and behind protection, with and without body armor), has been conducted in accordance with the DOT&E-approved combined LFT&E strategy and Event Design Plan.

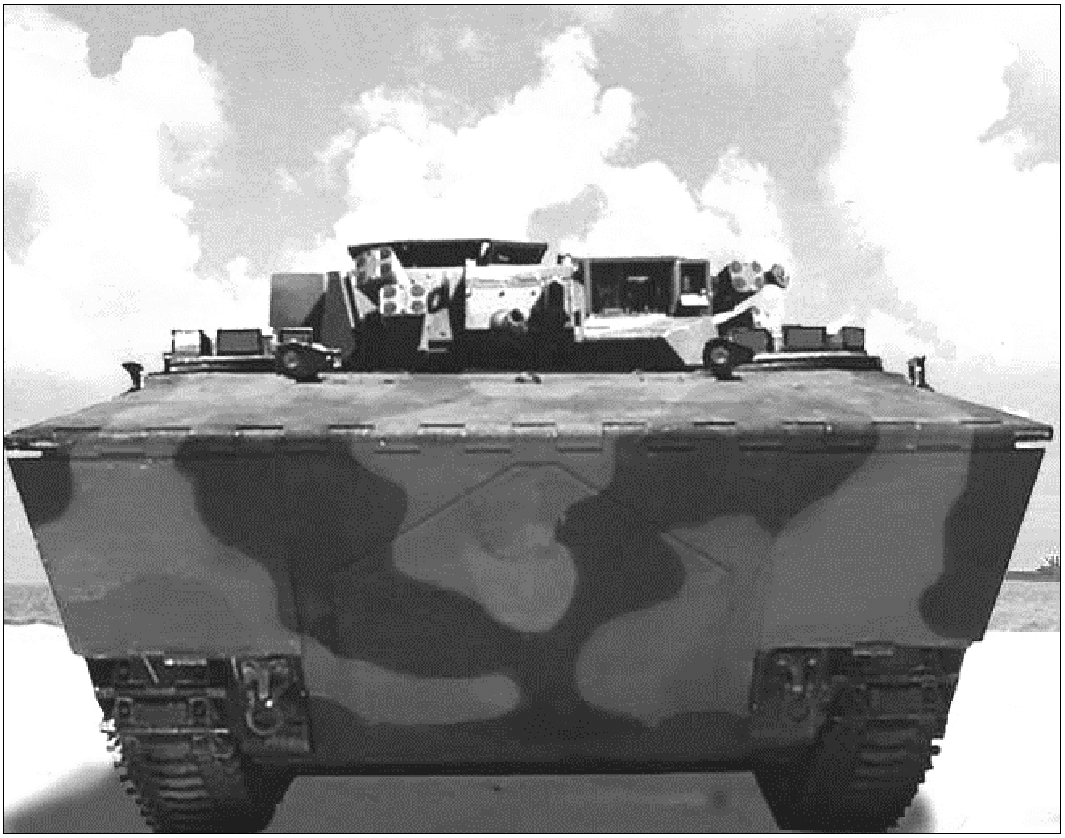
CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

LFT&E results confirmed that the XM1001 exceeded its hit accuracy requirement. According to the user, this munition will be used primarily for suppression of threats in a MOUT environment, so there is no explicit lethality requirement for the XM1001. Since the LFT&E program was based on dynamic shots at representative test targets, not only was its probability of a hit measured, but a measure of its kill potential was also determined. As might be expected for a munition of this type, demonstrated anti-personnel lethality was rather low. The user will likely need to fire more rounds than the typical three-to-five round burst to achieve an acceptable level of wounding.

PART IV

NAVY PROGRAMS

ADVANCED AMPHIBIOUS ASSAULT VEHICLE (AAAV)



Navy ACAT ID Program

Total Number of Systems:	1,013
AAAV(P) Personnel Variant:	935
AAAV(C) Command Variant:	78
Total Acquisition Cost (TY$):	$8,469M
Average Unit Cost (TY$):	$6.9M
Full-rate production Contract Award:	1QFY07

Prime Contractor
General Dynamics Land Systems

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Advanced Amphibious Assault Vehicle (AAAV) is an amphibious armored personnel carrier that will replace the current Marine Corps assault amphibian—the AAV7A1. The following two variants are under development: the personnel variant (AAAV(P)), which will be armed with a 30 mm cannon and a 7.62 mm machine gun, and is intended to transport 17 combat-equipped Marines and a three-man crew; and, a command and control variant (AAAV(C)), which will carry a commander and staff. An operationally configured AAAV is expected to weigh about 37 tons and travel in excess of 20 knots in 3-foot significant wave height water conditions, and at 43 miles per hour over land.

The AAAV is primarily designed to provide an over-the-horizon amphibious assault capability for Marine Air-Ground Task Force elements embarked aboard amphibious ships. Once ashore, the AAAV(P) will be an armored personnel carrier, providing transportation, protection, and direct fire support to accomplish ***dominant maneuver*** and ***precision engagement***; the AAAV(C) will serve as a tactical echelon command post.

BACKGROUND INFORMATION

The AAAV program entered the Preliminary Design-Risk Reduction (PDRR) phase after its Milestone (MS) I in 1995. The MS II Defense Acquisition Executive (DAE) review occurred on November 29, 2000. Based on the consensus of the Integrating-Integrated Product Team, the Program accelerated the MS II DAE from 2/3QFY01 to 1QFY01. Increased funding from Congress also contributed to the Program Office's ability to accelerate the MS II decision. MS III and Initial Operating Capability are scheduled for 4QFY06.

The AAAV program has made extensive use of the Integrated Product and Process Development concept in its test strategy development. The Program continues to evolve the T&E strategy and planning to best meet the needs of the Marine warfighters within tight fiscal and schedule constraints. The Program's Test and Evaluation Master Plan (TEMP) was approved by DOT&E on November 29, 2000.

The AAAV is under Live Fire Test and Evaluation (LFT&E) oversight for both system survivability and system lethality. The LFT&E strategy calls for a building block approach that begins at the component level and concludes with a full-up, system-level testing of an AAAV vehicle. The program completed its planned armor validation testing of selected armor coupons with the ORD-specified threats in FY99.

TEST & EVALUATION ACTIVITY

DOT&E required the program to conduct operational events to support the MS II decision. The U.S. Marine Corps Operational Test and Evaluation Activity (MCOTEA) conducted an Early Operational Assessment (EOA) to support the MS II DAB review. This EOA primarily consisted of technical demonstrations and operationally oriented DT test events. MCOTEA and DOT&E also reviewed other data, including DT, user juries, and field tests. Although these tests were not operational in nature, they were expected to provide some feedback to DOT&E and the Program Office on the system's potential operational effectiveness and suitability, and provide indications of system maturity to the DAE prior to his MS II decision. Available test and analytical data from DT, conducted using PDRR prototype vehicles, were evaluated in terms of their contributions to the objectives of the developmental program, and addressed other areas of technical risk that could significantly affect achieving the program objectives. Both MCOTEA and the Program Office restructured some planned pre-MS II DT events in order to obtain operational insights.

An EOA for the command variant will be accomplished through use of the AAAV(C) non-operational mockup and Systems Integration Lab (SIL) at the AAAV Technological Center in Woodbridge, VA. The EOA, scheduled for 4QFY01, will use the wooden mockup, which will be updated to present a realistic representation, with reasonable fidelity, of the Command, Control, Communications, Computers, and Intelligence (C^4I) suite that will be used on the Engineering and

Manufacturing Development (EMD) AAAV(C) vehicle. The physical mockup of the AAAV(C) internal configuration will be used for various human factor observations and insight. A functional representation of the communication suite, using operating, representative equipment in the mockup, will be used during exercises of test scenarios. A battalion and a regimental staff from the 2nd Marine Expeditionary Force (II MEF) will be used for this assessment. A Program-conducted user jury, scheduled for December 2000, will serve as a foundation for the AAAV(C) EOA, and will provide insights into the Command and Control (C^2) aspects of the AAAV program, clarification of C^2 employment, and guidance to the AAAV(C) EOA. This test plan is a result of close coordination and teamwork among MCOTEA, DOT&E, and the Program Office to optimize AAAV(C) early operational activities to prevent redundancies of effort. As a result, the AAAV(C) EOA has been re-scheduled from 4QFY00 to 4QFY01.

The Live Fire Testing and Evaluation (LFT&E) test activity during FY00 focused on the lethality of the 30 mm main gun ammunition and approval of the LFT&E strategy for assessing vehicle survivability. As part of the selection and development process for the ammunition, the program conducted firing of various high explosive and armor piercing ammunition designs against armor plates, threat vehicles, troop surrogates, watercraft targets, masonry targets, and earth and timber bunkers. All testing was conducted from test barrels or an experimental mount equipped with the Mk 44 gun. The final reports have not been provided by the PM, nor reviewed by DOT&E. Realistic lethality testing from a vehicle will be conducted in FY04.

TEST & EVALUATION ASSESSMENT

The acceleration of the MS II decision, adjustments to the AAAV(P) EOA timing, changes to AAAV(C) requirements by the USMC, and program level schedule adjustments to facilitate alignment of funding, contracting and major decision points resulted in the reduction of previously scheduled pre-MS II operational activities. As a result, DOT&E directed the Program Office to: (1) add a pre- Low-Rate Initial Production (LRIP) operational activity from FY01/FY03 to support the first LRIP decision; (2) accelerate the EMD Phase operational test in FY04 by six months to support the second LRIP decision; (3) add a Hot Weather Assessment in FY04 that combines DT and OT activities; and (5) ensure that the maximum number of LRIP vehicles were available for use in the FY06 IOT&E.

Per the MS I TEMP, the AAAV(P) EOA was originally scheduled in 4QFY01. Though intended for acceleration and completion by August 2000, the AAAV(P) EOA is now scheduled between 2QFY01-4QFY01. The shift will allow additional DT to be completed while avoiding operational schedule conflicts. During the AAAV(P) EOA, representative Marines will determine whether the system, when employed in an operationally realistic environment, has the potential to transport troops from an amphibious ship located over-the-horizon and then conduct sustained mechanized operations ashore with the main battle tank and other ground combat systems. This EOA should also provide an initial assessment of key factors affecting the system's operational suitability.

Risks associated with this modified test strategy include reduced system-level operational insights early in the acquisition process, reduced operational insight at the first LRIP decision point, and AAAV(C) variant LRIP decisions lacking operational testing of a representative configuration. However, due to the high degree of fidelity in the PDRR AAAV prototypes, and the corresponding improvements expected in EMD and LRIP articles, these risks should be mitigated. Furthermore, DOT&E and MCOTEA will be better able to identify operational effectiveness/suitability issues and risk during the conduct of each operational assessment and test event.

The Program Office will use data gathered during FY00 on the 30 mm ammunition to select high explosive ammunition for the AAAV. Simulations will be conducted based on the results of these tests to predict the effectiveness of the different ammunition types against threat targets. The program then plans to fire the selected ammunition against threat targets or surrogates from the Mk 46 mount on one of the prototype vehicles in early FY04 as a system-level test.

As part of the MS I TEMP approval, DOT&E requested that the PM update appropriate portions of the LFT&E Strategy one year prior to the commencement of Ballistic Hull and Turret (BH&T) testing. The PM had worked on developing this update through late FY99 and early FY00. In 2QFY00, the PM restructured the LFT&E Strategy, and the proposal constituted a substantial change from the MS I TEMP and prior working drafts. Working with the Deputy Director for LFT, the Program's strategy now includes the reduction in full-up, system-level test articles from two EMD vehicles to one, the addition of one PDRR prototype vehicle in late FY02 for Ballistic Vulnerability Testing, and the retention of BH&T testing in FY01. The risks associated with the reduction in the number of full-up, system-level assets and test shots, may be offset by the inclusion of the Ballistic Vulnerability Testing of a full-up PDRR prototype two years earlier in the acquisition cycle. This LFT&E strategy serves to reduce full-up, system level costs by approximately $16.4 million while only increasing EMD Phase LFT&E costs by approximately $1.85 million, a net savings of over $14 million.

Additionally, in response to DOT&E's request that the PM conduct limited full-up, system-level testing against the AAAV(C), the Program Office has incorporated a single non-perforating ballistic test event using an EMD-AAAV(C) vehicle in FY05. This event represents a realistic approach to a limited examination of the system-level vulnerabilities unique to the AAAV(C) variant configuration, and minimizes risk to potential destructive effects upon the single AAAV(C) EMD variant prior to IOT&E. The focus of this ballistic event is to identify risks associated with ballistic shock on the C^4I Suite inside an AAAV(C).

Development of the LFT&E strategy was unique in that the PM is the Marine Corps Evaluator for LFT&E. This arrangement results from the fact that SECNAV Instruction 5000.2R restricts MCOTEA involvement in LFT&E. Still unresolved at this time is how the adequacy of mine threats will be addressed. DOT&E will continue to work with the PM on this issue.

CONCLUSIONS AND LESSONS LEARNED

Due to the re-scheduling of the MS II DAB forward from 3QFY01 to 1QFY01, the short-term notice has resulted in less than optimal planning periods for the identification, development, and execution of OT&E-related events. Lessons learned include coordination of either concurrent or combined DT/OT events requires extensive and early cooperation and planning between MCOTEA and the Program Office. This will become extremely important as the program begins its planning for testing to be conducted in the EMD Phase. DOT&E will work with MCOTEA on the planning, coordination, and execution of DT/OT events to ensure preparations for the conduct of the Direct Reporting PM (DRPM) AAA's pre-LRIP operational assessment are effective.

The DRPM AAA's LFT&E Strategy currently allows for the early identification of risks associated with the present design. However, challenges associated with incorporation of early contractor developmental testing into a building block LFT&E strategy continued in FY00. The PM is relying on and has referenced several contractor-conducted tests and analyses, but has not provided documentation of the results to DOT&E. In many cases, the contractor's report will not be provided until after the MS II decision.

The DRPM AAA's status as the Service evaluator for LFT&E is less than optimal. The difficulties may be attributed to the lack of an independent agency within the Marine Corps responsible for LFT&E. However, the current Test and Evaluation Working Integrated Product Team process used by the Program Office may mitigate this oversight risk and the appearance of conflict of interest with the PM being its own evaluator.

ADVANCED COMBAT DIRECTION SYSTEM (ACDS) BLOCK I

Navy ACAT II Program*		**Prime Contractor**
Total Number of Systems:	5	Raytheon Systems Company
Total Program Cost (TY$):	$296.8M	Naval and Maritime Systems Division,
Average Unit Cost (TY$):	$10.3M back fit/ forward fit	San Diego, CA
Full-rate production:	N/A	

**See program status under Background Information*

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The AN/SYQ-20 Advanced Combat Direction System (ACDS) Block 1 consists of computer program software and associated hardware for non-Aegis combatant ships (aircraft carriers and selected amphibious warfare ships). ACDS Block 1 provides extended range display, expanded track capacity, Joint Tactical Information Distribution System interoperability, modifiable doctrine, display of mapping information, automatic gridlock, and doctrine-controlled multi-source identification. AN/SYQ-20 hardware includes computers, a display system with consoles, data terminal sets, automatic data processor, and automated status boards.

ACDS Block 1 is a combat direction system for aircraft carriers and amphibious warfare ships that supports the ***Joint Vision 2020*** concept of ***full-dimensional protection*** by providing control for a final layer of self-protection against threat "leakers" (air, surface, sub-surface) for individual ships. By ensuring such protection, ACDS Block 1 contributes indirectly to the concept of ***precision engagement***, enabling strike operations against targets to be executed from these platforms.

BACKGROUND INFORMATION

ACDS Block 1 represents the second phase of implementation of the Combat Direction System improvement plan of 1981, with ACDS Block 0 representing the initial phase. The Block 1 program was restructured in April 1991. Further adjustment occurred in FY93, targeting FY97 for fleet delivery of the software. Work to address deficiencies observed during 1997 testing delayed OPEVAL and the full production decision. OPEVAL was conducted in February 1998 in the Atlantic Fleet and Puerto Rican operating areas. As required by DOT&E, the OPEVAL included operations in a battle group environment. Based on OPEVAL results, ACDS Block 1 was assessed as neither operationally effective nor operationally suitable. Further OT&E, conducted in FY99, indicated that although improvement had been made, ACDS Block 1 was still deficient in certain areas such as human machine interface design (excessive actions required of operators to engage targets), computer program maintainability, and display console lockups. Subsequently and contrary to original plans, it was determined that ACDS Block 1 will be installed in no more than five ships (USS JOHN F. KENNEDY, USS DWIGHT D. EISENHOWER, USS WASP, USS NIMITZ, and USS IWO JIMA).

TEST & EVALUATION ACTIVITY

During FY00, ACDS Block 1 T&E was conducted as part of the risk-reduction T&E for the Cooperative Engagement Capability (CEC) OPEVAL. DT&E was conducted during May, September, and December 2000. The September period included one day of independent OT&E. A DOT&E representative observed the testing.

TEST & EVALUATION ASSESSMENT

Preliminary results from the September 2000 OT indicate improved reliability and stability of ACDS Block 1 relative to its performance during the FY99 OT and during the May 2000 CEC OT&E. Data are still being analyzed.

LESSONS LEARNED

Both the FY98 OPEVAL and subsequent OT provided reaffirmation of a lesson learned from earlier testing with other systems: performance of software-intensive systems intended to support control of complex defense missions (especially against fast-moving air threats) can only be adequately tested in a realistic operational environment. In the case of ACDS Block 1, this was done and included at-sea operations by the ACDS Block 1 ship with accompanying ships, along with a realistic number of air targets for radar tracking, identification, and threat prioritization by fleet operators.

ADVANCED INTEGRATED ELECTRONIC WARFARE SYSTEM (AIEWS) AN/SLY-2(V)

Navy ACAT II Program

Total Number of Systems:	173	
Total Program Cost ((TY$):	$1,172M	
Average Unit Cost (TY$):	$6.8M	
Full-rate production:	FY04	

Prime Contractor
Lockheed Martin
Syracuse, NY

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The AN/SLY-2(V) Advanced Integrated Electronic Warfare System (AIEWS) is the Navy's next-generation shipboard electronic warfare system planned for use with the Aegis Combat System and Ship Self Defense Systems. It is a total replacement for the AN/SLQ-32(V) system. Increment 1 of AIEWS will include the capability to detect and identify radio frequency emissions, provide precision angle of arrival information to cue hard-kill fire control system sensors, and launch self-protection decoy devices. Shown in the photograph is a demonstration antenna used during at-sea engineering tests. Integration of Increment 1 with the ship command and decision system will support other sensor cueing and combat identification. Increment 2 will include additional capability.

AIEWS is an electronic warfare system for surface combatant ships that support the ***Joint Vision 2020*** concept of ***full-dimensional protection*** by providing a final layer of self-protection against air threat "leakers" for individual ships and by assisting other self-protection engagement systems.

BACKGROUND INFORMATION

The Navy approved the Operational Requirements Document in April 1997. In November 1997, the Program Executive Officer agreed that for Increment 1 an OA would be conducted for the initial LRIP decision (FY01), followed by at-sea OT with a partially integrated combat system supporting a second LRIP decision (FY02). It was further agreed to conduct OPEVAL with AIEWS fully integrated with an Aegis Combat System, to support the full production decision in FY04; however, the acquisition decision memorandum from the December 1997 Milestone II review failed to reflect the November agreement. The initial TEMP was received by OSD in March 1998, and was returned to the Navy the following month without approval. The TEMP was not approved primarily because of the fundamental disconnect between the program structure (as agreed to by the PEO in November 1997) and the program structure reflected in the language of the Milestone II acquisition decision memorandum.

AIEWS development has fallen behind schedule and the initial installation will not be fully integrated with the host combat system. For initial installations, AIEWS will use the same interface as the system it will replace, the AN/SLQ-32(V) electronic warfare system. As a result of this descoped integration, some of the improved capability required of AIEWS cannot be fully used to benefit the combat system. For example, the improved precision angle of arrival information will not be available to cue hard-kill fire control system sensors. The program was re-baselined in FY00 as a result of cost and schedule breaches.

TEST & EVALUATION ACTIVITY

This activity consisted of conducting early at-sea engineering tests and defining the T&E program, with review and examination of the test resources available at the various test ranges, including plans for the land-based test site at Wallops Island, VA. Activity also included integration of an ASCM seeker with an existing target drone to provide a test asset that would mitigate OT community concerns about inadequacies of proposed ASCM simulators.

TEST & EVALUATION ASSESSMENT

There are no test results of sufficient scope on which a performance assessment can be based. Engineering tests were limited to examination of multi-path (path via sea surface reflection as well as direct path) effects. The Increment 1 T&E program will examine critical operational effectiveness issues, including situation awareness (the effective and accurate detection, track, and identification of radio frequency emitters); engagement support (effective employment of decoys against anti-ship cruise missiles), tactics and survivability. In addition, the T&E program will address the full spectrum of critical operational suitability issues: reliability, maintainability, availability, logistic supportability, training, human factors, compatibility, interoperability, documentation, and safety. As noted below, there are significant issues with the overall T&E program:

- AIEWS/Host Combat System Integration for OPEVAL. The fundamental disconnect between the program structure, as agreed to by the PEO, and the program structure as reflected in the Milestone II acquisition decision memorandum, remains unaddressed. Although the program is being re-baselined, program schedules continue to show IOT&E,

with an engineering development model AIEWS partially integrated with the host combat system using the existing interface to support a full production decision. Such OT&E should be used to support LRIP quantities. More meaningful OT&E, with a production-representative AIEWS fully integrated with the host combat system, should be used to support the full production (B-LRIP) decision.

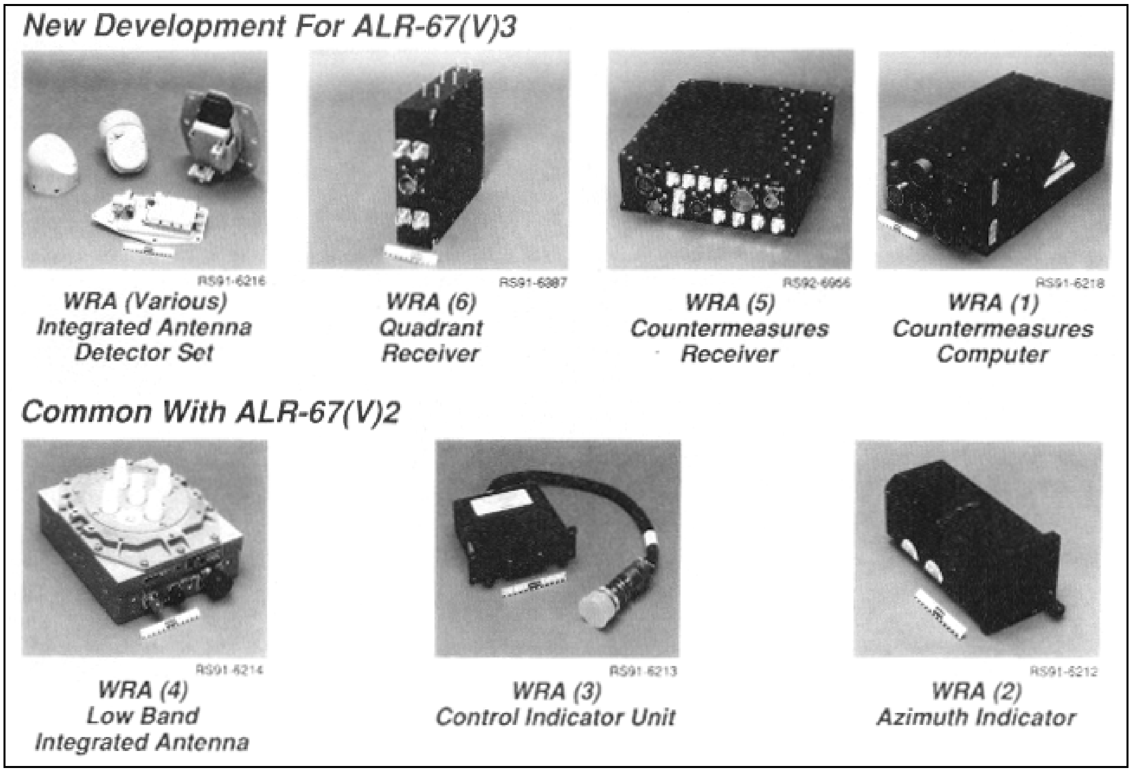
- ORD Ambiguity. The currently proposed initial AIEWS/Aegis interface significantly constrains the demonstration of the complete set of capabilities required by the ORD. Although the ORD asserts that it will "support the evolutionary development of capabilities to meet the operational requirements," it is ambiguous with regard to what initial functionality is required and the schedule for delivering additional capabilities. This requires ORD clarification and is being addressed.

- Realistic Simulation of Anti-Ship Cruise Missiles. The requirement is for a platform, with appropriate radar cross-section, that can carry anti-ship cruise missile radio frequency (RF) seekers or acceptable seeker simulators at threat-representative speeds and altitudes. The legacy simulation, identified upfront by the OT community as not meeting the requirement, uses a large, slow aircraft that cannot descend to threat-representative altitudes. COMOPTEVFOR and DOT&E have pursued the use of an existing target drone, integrated with an anti-ship cruise missile RF seeker. This demonstration project should result in flight demonstrations in FY01 well before the AIEWS OT. If this is an acceptable solution, adequate numbers of these drones will have to be funded for OT.

- Self Defense Test Ship for AIEWS Increment 2. It is expected that anti-ship cruise missiles or very high fidelity surrogates will be required for OT&E. This will necessitate a follow-on self defense test ship in order to simulate threat-representative anti-ship cruise missile profiles and conduct safe testing.

The issues of ORD Ambiguity and Realistic Simulation of Anti-Ship Cruise Missiles are being addressed. The issues of AIEWS/Host Combat System Integration for OPEVAL and a Self Defense Test Ship for AIEWS Increment 2 require satisfactory resolution.

ADVANCED SPECIAL RECEIVER (ASR) AN/ALR-67(V)3



Navy ACAT II Program		**Prime Contractor**
Total Number of Systems:	698	Raytheon
Total Program Cost (TY$):	$1.1B (acquisition)	
Average Unit Cost (TY$):	$1.1M	
Full-rate production:	4QFY99	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

Advanced Special Receiver (ASR) is a radar-warning receiver (RWR) intended to supersede the AN/ALR-67(V)2, and provides extended capabilities in detection and processing of air defense threat radars of the mid-1990s and beyond, thus contributing to Joint Vision's focus on ***information superiority*** and ***precision engagement*** of enemy forces. It functions cooperatively with the onboard suppression and defensive systems (high-speed anti-radiation missile (HARM)), countermeasure dispensers, and radio frequency (RF) jammer) via data exchanged over the Electronic Warfare multiplex bus and the HARM data bus. The (V)3 ASR is applicable to the F/A-18C/D/E/F. The (V)4 ASR will be applicable to the F-14A/B upgrade, and F-14D, however the AV-8B portion has been canceled. Except for WRA-5, which is split into two parts to alleviate F/A-18 tail structural limitations, and new brackets required for antennas and additional wiring, the bulk of ASR hardware is a form and fit replacement for AN/ALR-67E(V)2 hardware. ASR provides an order of magnitude increase in processing power. ASR collection categories include: (1) high band pulse (2-18 GHz); (2) high band continuous wave; (3) low band pulse less than 2 GHz; and (4) millimeter wave MMW (28-40 GHz). ASR provides signal detection, direction finding, and identification of RF and MMW threat emitters including scanning, pulse-Doppler and continuous wave tracking, acquisition and early warning radar, and missile guidance. The Low Band Integrated Array in the ASR was not changed from the ALR-67E(V)2. The software re-programmable threat library user data file (UDF) development and maintenance process and infrastructure for the ASR is intended to support improved operational timeliness of UDF updates (i.e., tactical reprogramming).

The AN/ALR-67 (V)3 Advanced Special Receiver (ASR) contributes to ***full-dimensional protection*** by improving individual aircraft probability of survival through improved aircrew situational awareness of the radar-guided threat environment.

BACKGROUND INFORMATION

The ASR is a Navy program that achieved Milestone II in 2QFY87 and Milestone III in 3QFY99. At the present time, the ASR program is in full-rate production for the F/A-18E/F aircraft.

DT&E was conducted at NAWC-AD Patuxent River, NAWC-WD China Lake, NAWC-WD Pt. Mugu, Air Force Material Command Western Test Range, and at contractor facilities from 1992-1998. ALR-67 (V)3 was deployed to the NATO exercise Trial Mace IX in 1QFY98. This deployment provided an opportunity to validate system performance in an open-air environment against several Gray emitters that were not available in the U.S. T&E infrastructure, except as Hardware-in-the-Loop or installed system test facility simulations. At the completion of DT with OT assistance, a determination was made by the program director that ALR-67 (V)3 hardware/software had sufficiently matured to enter technical evaluation (the final phase of DT&E) and OT-IIA.

OT-IIA was conducted from October 1997-January 1998. OT-IIA was conducted in an operational threat environment derived from threat data contained in the Office of Naval Intelligence Threat Assessment (014-97). The purpose of OT-IIA was to assess the potential operational effectiveness and operational suitability of the ALR-67 (V)3 system to support an LRIP decision. As a result of OT-IIA, COMOPTEVFOR concluded that the system was potentially operationally effective and potentially operationally suitable with recommended improvements in identification, localization (Direction Finding accuracy), Built-In Test (BIT), reliability, maintainability, and reprogrammability. These and other changes were incorporated into the design tested in OT-IIB (OPEVAL).

OT-IIB was conducted from June 1998-February 1999 in an operational threat environment, with over 550 sorties and 967 flight hours flown. The purpose of OT-IIB was to determine the operational effectiveness and suitability of the ALR-67 (V)3 system, and to continue tactics development to support promulgation of the OPTEVFOR tactics guide. OT&E was conducted at Eglin AFB (Florida), Sardinia (Italy), the ECR (China Lake), Nellis AFB (Nevada), Alaska, and onboard an aircraft carrier operating off the coast of Southern California. ALR-67 (V)3 was examined in two operational scenarios—four F-16s versus four F/A-18s at Nellis AFB, and in a combined air and ground scenario with a robust Integrated Air Defense System known as the Graduation Exercise at China Lake. Individual aspects of system performance were evaluated during both operational scenarios and other operational testing at China Lake.

Analysis of operational testing included both qualitative and quantitative measures documenting direct system performance measures and evaluation of system performance via pilot reports. A key feature throughout the evaluation was direct side-by-side comparisons by the same pilots in the same scenarios with the current F/A-18 RWR, the ALR-67E (V)2. Based on results from OPEVAL completed in February 1999, the August 1999 B-LRIP report stated that ASR was operationally effective and operationally suitable on the F/A-18C/D. ALR-67 (V)3 demonstrated improved detection, identification, localization, and warning to a wide range of threat RF radar systems when compared to the ALR-67E (V)2. It also demonstrated that it improved pilot situational awareness, contributing to more effective mission accomplishment. The ALR-67 (V)3 demonstrated overall high reliability during flight testing with 23 mission critical and nine non-mission critical failures during 967 flight hours. Of the failures, nine were due to BIT false alarms, seven were due to radome or antenna failures, six were due to actual hardware failures of the weapons replaceable assemblies (WRAs), and the rest were software and non-critical failures. Analysis of failure data indicates the system meets objective criteria in most cases, with antenna radome reliability, system maintainability, and logistics supportability as areas needing improvement. The demonstrated Mean Time Between Critical Failure was 42 hours (threshold was 17 hours).

Immediately following the completion of ALR-67(V)3 OPEVAL, the system entered FOT&E on the F/A-18E/F during that aircraft's OPEVAL.

TEST & EVALUATION ACTIVITY

Based on OPEVAL results, DOT&E has identified the following items to be resolved during FOT&E (with no particular timeline): (1) identifying and correcting the causes of ALR-67(V)3 radome/antenna failures; (2) correcting maintainability/logistic supportability issues; (3) verifying and re-testing system MMW performance; (4) improving system BIT interpretability and troubleshooting guides; (5) correcting threat signal blanking between the ALR-67(V)3 and ALQ-126B; (6) demonstrating the capability to create and promulgate an operational UDF in a timely manner; and (7) completing ALR-67(V)3 user manuals. Additional recommended improvements include: (1) correcting joint interoperability and identification of friendly AI radar problems; (2) improving the Inertial Navigation System smoothing rate to provide the most accurate estimate of threat placement (RWR display symbology); and (3) improving the HARM command launch computer interface to properly indicate actual HARM status rather than an ALR-67(V)3 degrade when the last HARM is expended.

Two issues were specifically identified to be resolved prior to FOT&E: (1) misidentification of one mode of a Blue AI radar as a more lethal mode, and (2) reduction or elimination of master resets.

The purpose of FOT&E, which ran from June-November 1999, was to resolve some of the issues identified above, and to determine system operational effectiveness and operational suitability as installed on the F/A-18E/F. The (V)3 was evaluated on five different F/A-18E/F aircraft and accumulated 627 flight hours and 183 catapult launches and arrested landings during 445 sorties. FOT&E was conducted at the ECR (China Lake) and adjoining air space, NAS Key West, FL, Nellis AFB, NV, and aboard an aircraft carrier.

TEST & EVALUATION ASSESSMENT

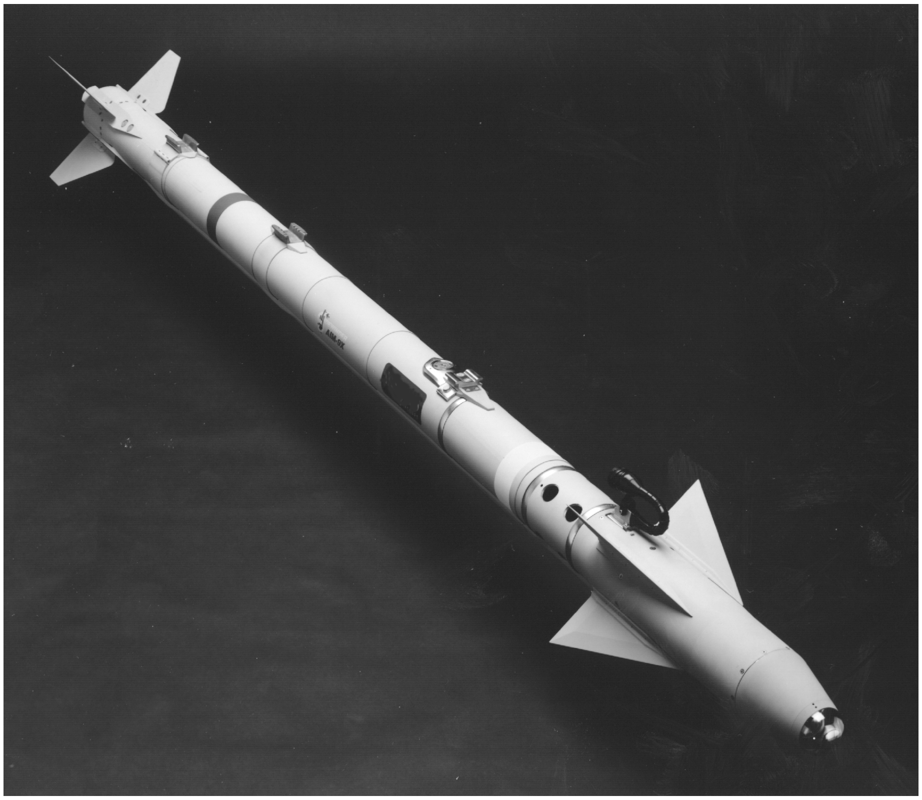
FOT&E determined the (V)3 to be operationally effective, but not operationally suitable on the F/A-18E/F, and did not recommend fleet introduction until able to identify and correct the cause of: (1) uncommanded power downs; (2) aft radome failures; (3) wire bundle chafing; (4) high BIT false alarm rates. Of the issues specifically identified by OPTEVFOR for correction and re-test, the first was corrected (Blue AI identification), while the second was not (master resets). MMW performance was re-tested and found to be satisfactory, and the user manual was completed and found to be adequate.

All the above, except the radome failures which were identified during OPEVAL, are issues unique to the installation of the ALR-67(V)3 on the F/A-18E/F.

Of the old and new issues awaiting correction and re-test, three are likely to be the most difficult to resolve: (1) BIT interpretability and false alarm rate; (2) system master resets; and (3) logistic supportability (USM-406D). All three are issues that frequently plague EW systems from cradle to grave, and reduce readiness and system supportability.

DOT&E will continue to monitor and report ALR-67 (V)3 test and evaluation activity until all issues identified in the BLRIP report are resolved. The Navy has embarked on a proactive program to correct deficiencies noted during OT-IIB and FOT&E to ensure an operationally effective and suitable system prior to fleet introduction. A Verification of Correction of Deficiencies identified during FOT&E is scheduled for FY01.

AIM-9X SIDEWINDER AIR-TO-AIR MISSILE



Navy ACAT ID Program

Total Number of Systems:	10,097
Total Program Cost (TY$):	$3.0B
Average Unit Cost (BY97$):	$245K
Full-rate production:	1QFY04

Prime Contractor

Raytheon Systems Company

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The multi-Service AIM-9X Sidewinder Air-to-Air missile program is a follow-on modification to the existing AIM-9M short range missile, for both the U.S. Air Force and Navy/Marine Corps fighters. AIM-9X is designed to be a highly maneuverable, launch and leave missile, capable of engaging multiple types of targets using passive infrared guidance to provide full day/night capability with improved resistance to countermeasures, expanded target acquisition, and high off-boresight improvements relative to the AIM-9M. AIM-9X is designed to work with any on-board aircraft cueing source, including the Joint Helmet-Mounted Cueing System (JHMCS), which is being developed in a parallel program to enhance high off-boresight capability.

The AIM-9X missile retains the warhead, fuze, and rocket motor of the existing Sidewinder missile family. A new imaging infrared focal plane array seeker, thrust-vectored tail-control actuation system, and state-of-the-art signal processor/auto pilot should provide the missile with performance improvements over AIM-9M.

AIM-9X will be employed in both offensive and defensive counter air operations. It will contribute to the ***Joint Vision 2020*** objectives of ***precision engagement*** in the offensive counter air role and to ***full-dimensional protection*** in the defensive counter air role. The F-15C/D and F/A-18C/D will be the initial fighter platforms for AIM-9X integration and testing; the missile will be integrated with the F-16, F/A-18E/F, F-15E, and F-22 later.

BACKGROUND INFORMATION

AIM-9X development was initiated in response to the development and fielding of new foreign missiles clearly exceeding AIM-9M capabilities. An 18-month AIM-9X competitive DEM/VAL program began in 1994 with the Hughes Missile Systems Company and the Raytheon Company. At the conclusion of this Dem/Val program, Hughes was selected as the AIM-9X prime contractor in December 1996. An evaluation of the British ASRAAM missile, conducted in parallel with the AIM-9X Dem/Val phase, including a 18-month Foreign Comparison Test, showed that it did not meet all of the U.S. performance requirements.

The AIM-9X program is a joint Navy/Air Force program, with the Navy designated as the Executive Service. It is also an acquisition reform program in which the contractor bears total system performance responsibility for a weapon system that meets the Performance Specification (AS-5780) derived from the Operational Requirements Document (ORD). The contractor, now Raytheon Systems Company through a merger with the Hughes Missile Systems Company, is developing AIM-9X through an Integrated Product Team (IPT) management approach including Navy, Air Force, and OSD membership. The EMD phase began in January 1997, and is currently planned for completion in approximately six years, with Milestone III scheduled for 3QFY03.

TEST & EVALUATION ACTIVITY

AIM-9X test and evaluation activity has proceeded from laboratory and captive carry development and demonstration tasks to missile test launches from F-15s and F/A-18C/Ds. Twelve of sixteen planned separation and control test vehicle (SCTV) launches were conducted to demonstrate safe separation and missile aerodynamic performance. The first three launches were successful. The fourth launch was not, due to a structural failure of the external harness cover resulting in separation of the electrical wiring to the control actuation system. The subsequent eight launches have demonstrated a fix for the harness cover design. An additional spare SCTV was launched to validate a new aft missile hanger design corrected launcher for damage previously seen on high G launches of both AIM-9X and existing legacy AIM-9M from the F/A-18C/D wingtip stations—the fix worked. One SCTV, planned to induce missile flutter if present, was inadvertently dropped into the Gulf of Mexico on the Eglin AFB test range after an uncommanded jettison from an F-15 (aircraft jettison switch wiring problem). Within two weeks, the AIM-9X program launched a spare SCTV, which showed no evidence of flutter.

During the DT-IIB/C test phase of the program, four Engineering Development Model (EDM) guided missiles and one Production Representative Model (PRM) guided missile have been successfully launched. The first EDM, which was an aft quarter shot, (better than the AIM-9M capability) destroyed the QF-4 drone. The second EDM killed a QF-4 drone in a head-on, lookdown, shoot-down attack over land with acquisition ranges in clutter superior to AIM-9M. The third shot was a wide miss. As a result, tracker algorithm problems were identified and corrected. The final EDM DT shot was a one circle engagement (better than the AIM-9M capability) against a QF-4 drone in a desert background with infrared countermeasures (IRCM). The aircrew utilized the Joint Helmet Mounted Cueing System (JHMCS) as a cueing source in this high off-boresight launch. The missile passed within lethal range for a kill of the QF-4 drone. The first PRM launch successfully intercepted the QF-4 drone (target in a beam aspect dispensing IRCM against desert background).

In the OT-IIA Operational Assessment, all five EDM launches have been completed using operational representative scenarios. JHMCS was also employed as a cueing source on three of these shots. Four EDM firings were direct hits and one EDM (target in a beam aspect dispensing IRCM against desert background) missed. The known throughput limitations of the EDM hardware, coupled with attendant software workarounds, contributed to this miss. Though conducted earlier in the calendar year, due to operational test resource availability, the DT PRM shot, mentioned above, was conducted in a target in a beam aspect scenario while dispensing countermeasures, and was successful. Based on simulation runs and this successful PRM launch, the PRM missiles have demonstrated significant improvement in throughput capability.

Modeling and simulation (M&S) tools are key contributors to the development and evaluation of AIM-9X. Due to this missile's expanded capabilities and cost constraints on the number of test launches, a family of simulations will be used to assess missile performance across a wide spectrum of engagements (encompassing various threats, backgrounds, and countermeasures). These simulations will approximate the missile's performance in target detection and acquisition, fly out to the target, and end game warhead fuzing and lethality. The live missile launches will be primarily used to validate these simulations. Since the same simulations will be used for the OT&E and DT&E phase, DOT&E and the OTAs have been involved in the AIM-9X program's intensive M&S planning from the program start. From an independent Draper Lab assessment of the M&S strategy, through the decision to contract with the Joint Accreditation Support Activity to assist in validation of the simulations, DOT&E has actively monitored M&S planning and operations. Validation, verification, and accreditation plans were developed for DOT&E approval. Technical review panels and accreditation panels continue to review M&S activities to support accreditation for LRIP and Milestone III decisions. This active involvement will continue throughout this challenging and important contractor/government task in EMD

The Live Fire Test and Evaluation program consisted of three warhead (same warhead as AIM-9M) characterization (static) tests, to determine if the added wiring harness and cover affected warhead performance. Testing was conducted March-April 2000 at China Lake, CA. The classified test data is being analyzed to determine if the warhead model requires revision. The LFT&E program was expanded when a primary threat target became available for testing. Static arena testing of the AIM-9X warhead against this target was conducted from September-October 1999 at Dahlgren, VA. This testing demonstrated the lethality of the AIM-9X warhead against its primary target for several expected endgame geometries. Test results will also support validation of the Joint Service Endgame Model, which will be used in determination of AIM-9X probability of kill.

TEST & EVALUATION ASSESSMENT

The AIM-9X development program was restructured in FY00 to compensate for an 8-month delay in the start of flight testing and the zeroing of FY00 procurement funding by Congress. The restructured schedule impact on OT&E resulted in shifting the final OT period from December 2000-October 2001 to December 2001-September 2002. Milestone III has also shifted from May 2002 to May 2003. The Congressional zeroing of the planned FY00 procurement forced the first of three planned LRIPs to begin 1QFY01. The APB and TEMP have been staffed reflecting these changes and the AIM-

9X program has been successfully executing the restructured program for 8 months having conducted over 495 captive, dress, and live launch missions. A fortuitous result of this schedule change is that more mature production representative missiles will be available for OT&E launches.

Development of the simulation suite is progressing well. Contractor and government stakeholders are cooperating in solving the simulation and interface problems as they occur. Validation of the simulation suite continues to be done with both the SCTV missile firings as well as the guided missile firings, including both the EDM and PRM missiles. Simulation strategy and planning is documented in the current TEMP revision approved by OSD in July 2000. This TEMP update restructured the test program to reflect the program schedule change, as well as support the FY00 119-missile LRIP budget request.

The simulation results from past Weapon System Performance Reviews (WSPR) have been based on EDM hardware and software. Although the EDM configuration meets ORD thresholds against blue-sky backgrounds, it does not currently meet ORD thresholds against targets dispensing countermeasures. However, the PRM configuration is expected to continue maturation of tracker hardware and software as planned to meet ORD probability of kill (Pk) thresholds against the threat target employing countermeasures in clutter backgrounds. The fifth WSPR, held in August 2000, presented the improved AIM-9X capability resulting from the changes made to PRM processor hardware and tracker software. Although 15 months of developmental testing still remain before OT&E, Pk values in IRCM and clutter, that approach ORD thresholds, are expected. DOT&E will closely monitor the program's progress in this area.

After completion of the OT-IIA Operational Assessment, approximately eleven more developmental PRM launches are planned before OT-IIB OT&E begins in December 2001.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

The AIM-9X program demonstrates the benefits of a cooperative IPT approach by involving the prime contractor, program management, Air Force and Navy test organizations, AFOTEC/COMOPTEVFOR, and OSD in developing a practical and credible simulation strategy supporting missile development and operational test and evaluation.

The AIM-9X program has invested heavily in modeling and simulation to support development and testing, including simulation of potential threats, backgrounds, and countermeasures. This simulation suite is being relied upon to guide development of the new missile seeker and tracker, especially in providing acceptable capability against countermeasures. An independent service and OSD team has accredited the AIM-9X simulation suite for the September 2000 LRIP DAB. These simulation initiatives have allowed the number of guided test missiles to be significantly reduced. The AIM-9X program is conducting up to 27 developmental test (10 of 11 successful to date) and 22 OT&E guided missile launches. This can be compared to 103 development and 69 OT&E guided launches that the AMRAAM program conducted in the 1980s. Accordingly, if test results with these few missiles do not meet operational requirements or do not agree with simulation results, additional test missile firings will be required.

ARLEIGH BURKE (DDG-51) CLASS GUIDED MISSILE DESTROYER WITH THE AN/SPY-1D RADAR

Navy ACAT IC Program		**Prime Contractor**
Total Number of Systems:	58	Bath Iron Works (Shipbuilder)
Total Program Cost (TY$):	$55,807.6M	Ingalls Shipbuilding, Inc. (Shipbuilder)
Average Unit Cost (TY$):	$962.2M	Lockheed Martin (AEGIS Weapon System)
Full-rate production:	1QFY87	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The ARLEIGH BURKE (DDG 51) class of multi-mission, guided missile, and battle force capable destroyers form the core of the Navy's surface combatant force for the 1990s and beyond. These ships are designed for forward presence and are capable of ***precision engagement*** of targets ashore, ***full-dimensional protection*** of joint and allied forces, and ***dominant maneuver*** while operating at sea and in the littorals. As described in the section on the Navy Area Theater Ballistic Missile Defense, planned upgrades to the AEGIS Weapon System and Standard Missile will also give DDG 51 a ballistic missile defense capability. DDG 51's armament includes a mix of 90 missiles to support its missions, housed in two MK-41 vertical launch systems. The ship uses a computer-controlled machinery control system and an up-rated LM 2500 gas turbine propulsion system to provide a maximum speed of at least 30 knots. The AEGIS Weapon System (AWS), which includes the SPY-1D radar and vertically launched SM-2 surface-to-air missiles, provides DDG 51's area defense anti-air warfare capability. The Phalanx close-in weapons system, along with the SM-2 missiles and gun, provides self-defense against anti-ship missiles. For Anti-Submarine Warfare (ASW), DDG 51 uses the SQQ-89 surface ASW combat system, the LAMPS MK III ASW helicopter, over-the-side torpedoes, and vertically launched ASW standoff weapons. DDG 51 also employs TOMAHAWK and HARPOON missiles, and has a 5-inch gun for anti-surface and strike warfare missions. The DDG 51 AEGIS Combat System is the integration of the AWS, the SQQ-89, and the ship's anti-surface, strike warfare and self-defense systems.

DDG 51s are being constructed in flights to incorporate technological advancements during construction. Flight II, authorized in FY92, incorporates improvements to the SPY radar and communications systems and adds active electronic countermeasures. Flight IIA, authorized in FY94, adds hangar facilities to accommodate two helicopters, removes HARPOON and the AN/SQR-19 towed array sonar system, replaces Phalanx with the Evolved Sea Sparrow Missile, and upgrades the 5-inch gun to add the capability of firing extended range guided munitions. FOT&E of a Flight IIA ship will occur in FY02.

The SPY-1D radar system is the multi-function, phased-array, three-dimensional (range, altitude, and bearing) radar that conducts search, automatic detection, and tracking of air and surface targets. The SPY-1D also provides mid-course guidance for the SM-2 missile. SPY-1D is a variant of the SPY-1B radar system on later TICONDEROGA (CG 47) class cruisers tailored for a destroyer-sized ship. The AN/SPY-1D(V), intended for installation in later Flight IIA ships, is an improved system with better performance against targets in clutter, additional moving target indicator wave forms, and greater ability to counter deceptive electronic attack measures.

BACKGROUND INFORMATION

The DDG 51 program has undergone continuing OT&E since inception. DOT&E's FY91 report contains a complete summary of the eleven periods of testing prior to commissioning of the lead ship, along with assessments and a discussion of significant deficiencies. The results of the first at-sea testing of the Flight I ship, conducted in DDG 51, were detailed in DOT&E's FY92 report. The results of subsequent FOT&E to reexamine ASW effectiveness and the effectiveness and suitability of the Gun Weapon System were reported in DOT&E's FY94 and FY96 reports. The Flight I LFT&E Program, which included a 1994 Shock Trial and a 1995 Total Ship Survivability Trial, is complete.

The AN/SPY-1D(V) underwent the first phase of OT in FY96. The test was conducted at the Aegis land-based test site at Moorestown, NJ, and examined performance of the radar engineering development model against simulated and actual targets in both clear and electronic attack conditions. SPY-1D(V) demonstrated better low altitude detection and performance in clutter than the operational SPY-1D radar. Based on these results, COMOPTEVFOR found the improved radar potentially operationally effective and suitable and recommended continued development. The Navy authorized LRIP in January 1997 and plans to install SPY-1D(V) in DDG 91 and later ships.

TEST & EVALUATION ACTIVITY

During October 1999, Phase I of Flight II FOT&E (OT-IIID1), was conducted in conjunction with DDG 75 Combat System Ship Qualification Trials (CSSQT) at the Atlantic Fleet Weapons Training Facility. The principal objective of this phase of testing was to spot-check the ship's effectiveness in areas most likely affected by introduction of the AEGIS Baseline 5.3.7 computer programs and other Flight II changes. Test events emphasized air defense and included tracking of manned aircraft and unmanned target drones in a variety of ECM environments, Standard Missile (SM)-2 engagements, and a gun engagement against a high-speed maneuvering surface target. This period was used as an opportunity to verify that selected deficiencies identified in earlier testing had been corrected.

AEGIS Baseline 5.3.7 underwent joint interoperability certification in November 1999. Following an abbreviated period of observation marked by test-related connectivity, testbed configuration, and crypto equipment difficulties, the Joint Interoperability Test Command (JITC) declared the evaluation an incomplete test. In response to a Joint Staff request, the Navy completed the joint interoperability evaluation in November 2000.

Phase II of Flight II FOT&E (OT-IIID2) was completed during a ten-day period in March 2000 while the USS GEORGE WASHINGTON (CVN 73) battle group was conducting its Composite Training Unit Exercise in the Gulf of Mexico. This was the first systematic operational test of DDG 51 class interoperability with other carrier battle group units. It afforded an opportunity for an in-depth examination of the interoperability among the AEGIS Baseline 5.3.7 combat system in DDG 75, earlier AEGIS baselines installed in cruisers and destroyers, and other combat systems found in the ships and aircraft of today's carrier battle groups. Test scenarios once again focused on air defense exercises. Selected aspects of DDG 51 Flight II operational suitability were also evaluated during this phase of testing.

FOT&E of AN/SPY-1D was conducted concurrently with DDG 51 Flight II FOT&E to evaluate the effectiveness of computer program modifications and the newly-added Track Initiation Processor and provide an updated assessment of the radar's operational suitability.

Throughout the year, DOT&E participated in a series of Test and Evaluation Working Groups chartered to develop plans for DT and OT of the Flight IIA ship (DT/OT-IIIE). Early risk-reduction DT began during DDG 79 and DDG 80 CSSQTs scheduled September-December 2000. Work on the TEMP revision required to support Flight IIA and AN/SPY-1D(V) testing is also underway.

DOT&E received the Navy's DDG 51 Flight I Mission Keeping Design Level Assessment in December 1999. After reviewing this report, DOT&E requested additional information on the Navy's plan for implementation of the recommended design changes in both existing and future ships. To date, not all of the requested information has been provided. DOT&E plans to submit its independent LFT&E assessment of the DDG 51 Flight I ship in FY01.

As part of the LFT&E survivability assessment for the Flight II and IIA ships, the Navy and DOT&E worked together to review the primary damage analysis results and select 15 hits for secondary damage (e.g., fire, smoke, flooding) analysis. With DOT&E participation, this list was pared to 6 significant hits for damage scenario-based engineering analysis and selection of four hits for the January 2001 Total Ship Survivability Trial (TSST) in DDG 79. DOT&E participated in ship checks for the selected scenarios as well as initial checks of the drill guides.

The Navy is completing preparations for a Flight IIA Shock Trial to be conducted during FY01. In late FY00, after the Program Manager had submitted a request for an additional $4.9M for the Shock Trial, DOT&E learned the Navy Comptroller had frozen all DDG 81 Shock Trial funds. DOT&E requested SECNAV take action to restore the funding for this singularly important trial (and those funds have been restored.)

In October 1999, the Program Executive Officer, Theater Surface Combatants, approved a plan to accredit all modeling and simulation used for assessing ship vulnerability. As a result of this effort, the Navy and DOT&E is gaining new insight into the many models and simulations used for assessing ship vulnerability. In particular, questions concerning the credibility of the Total Mine Simulation System prompted the Program Manager to conduct a mine susceptibility trial in August 2000. This trial, which was observed by DOT&E, will provide data to support an analysis of the ship's susceptibility to selected mine threats and accreditation of the modeling and simulation. In August 2000, the DDG 51 LFT&E Accreditation Review Panel met for the first time to consider accreditation of the Naval Research Laboratory's Radar Target Signature model and CRUISE Missiles missile engagement model. The accreditation of several other models is in progress.

TEST & EVALUATION ASSESSMENT

In keeping with the department's efforts to achieve efficiencies by combining operational testing with DT and training events whenever possible, DDG 51 Flight II FOT&E (OT-IIID) was overlaid onto a collage of such events. In addition to the obvious economies, this approach fostered a close working relationship between the OT and DT communities and allowed the OTA to capitalize on the depth of the AEGIS technical community. In retrospect, however, this collaboration resulted in combined DT/OT that was heavily weighted toward technical objectives. This diminished the "top-down" focus, operational realism and tactical spontaneity usually associated with OT. Although the test ships were operated and maintained by Navy crews, technicians were on hand during CSSQT events to support the operators, and the operators were briefed on DT/OT scenarios in advance. These circumstances do not measurably detract from our ability to evaluate the performance of the SPY-1D radar and other DDG 51 combat systems, but they limit our ability to assess the crew's ability to employ the combat system effectively when faced with the uncertainties and ambiguities that characterize the operational environment.

The primary objective of FOT&E was to evaluate the impact of the changes introduced in the Flight II configuration and AEGIS Baseline 5.3.7 computer program on the ship's operational effectiveness and operational suitability. That objective was not fully achieved. The contribution of the AN/SRS-1(V) Combat Direction Finding system and the Global Command and Control System could not be evaluated because they were not certified ready for OT. Lack of a suitable target precluded evaluation of the effectiveness of the active ECM features of the AN/SLQ-32(V)3. While we continue to assess the SPY-1D radar to be effective and suitable, the test did not provide any quantitative basis for evaluation of the contribution of the new Track Initiation Processor.

Although FOT&E lacked the discriminating power needed to measure the improvement in effectiveness resulting from Flight II upgrades, it provided substantial evidence that the changes did not degrade effectiveness or suitability. It also provided evidence that the Baseline 5.3.7 computer program is stable and devoid of significant deficiencies.

Although examined extensively as part of the LFT&E susceptibility analyses, DDG 51's ability to defeat anti-ship missiles with soft-kill measures has not been evaluated during operational testing because the Navy does not have accredited targets.

Battle Group interoperability testing conducted in FY00 as part of Phase II of OT-IID Flight II FOT&E, established an important performance baseline in an area where there are currently no quantitative performance requirements. Although the AEGIS Baseline 5.3.7 combat system has fewer interoperability problems than earlier baselines, testing highlighted several issues that can degrade situational awareness including the need for an improved contact identification capability and the need more effective training of ship's crew in the use of Link 4A and Tactical Data Link management.

DDG 51 FOT&E did not address the ship's undersea warfare capability since Flight II changes had no impact on that area. However, operational testing of the AN/SQQ-89(V)6 Surface Undersea Warfare Combat System with Torpedo Alertment Upgrade conducted in DDG 78 (a Flight II ship) showed that the DDG 51 class is still at a disadvantage in a one on one encounter with a submarine. A detailed discussion of these test results is provided in the Integrated Surface Ship ASW Combat System (AN/SQQ-89) section of this report.

DDG 75 demonstrated the capability to defeat a single high-speed, maneuvering surface target simulating the patrol boat threat during OT-IIID. Burst patterns from 15 percent of the projectiles fired by the ship's 5-inch gun mount were considered target hits and another 24 percent were counted as near misses. Since the crew was fully alerted in this event, we are unable to assess whether comparable results could be achieved in a tactically realistic scenario. Additional testing to examine the ship's effectiveness against multiple surface targets is planned for future FOT&E.

Gun Weapon System effectiveness against slow-moving aircraft and helicopters remains unresolved pending allocation of suitable targets. Projectile tracking, which might enhance the ship's effectiveness against surface threats and shore batteries, has not yet been implemented for fleet use. DOT&E is reviewing the OTA determination that most of the deficiencies noted in earlier Gun Weapon System testing have been corrected. Gun reliability, which was unsatisfactory in earlier test results, was not re-examined during OT-IIID. Operational effectiveness and suitability of the new Mk 34 Mod 1 Gun Weapon System and the longer range Mk 45 Mod 4 Gun Mount will be evaluated during Flight IIA FOT&E.

From an LFT&E perspective, the Navy is not using the shock trial results to maximum advantage. For example, finite element modeling would provide a more reliable method of extrapolating shock trial results beyond the limits of testing. For Flight IIA, the Navy began a physics-based Shock Trial Simulation Project, which consisted of finite element modeling of the full ship to make pre-shock trial predictions. However, the project was canceled in early FY00 when it became clear that the project would not be completed in time to support the DDG 81 Shock Trial.

Since the shock trial is conducted at less than design level, it should not be relied upon as the sole basis for shock qualification of major equipment and systems. Currently, there is no planned or funded component shock qualification program for the upgraded 5-inch gun being installed in the Flight IIA ships beginning with DDG 81. In January 1999, DOT&E asked the Assistant Secretary of the Navy, Research, Development and Acquisition, to address this concern.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

The long and continuing Operational Test program associated with the DDG 51 has been very effective. The AEGIS program office conducts an aggressive program of ship system testing to explore the boundaries of DDG 51 performance, identify deficiencies, and develop enhancements to hardware and computer programs. This program office was an early proponent of combined DT/OT and fully supports efforts to achieve efficiencies through combining testing and training wherever possible. Although such combined events have largely been successful in the past, operational testers need to exercise greater control over test planning to ensure that future tests adequately address the salient OT objectives and incorporate more operational realism.

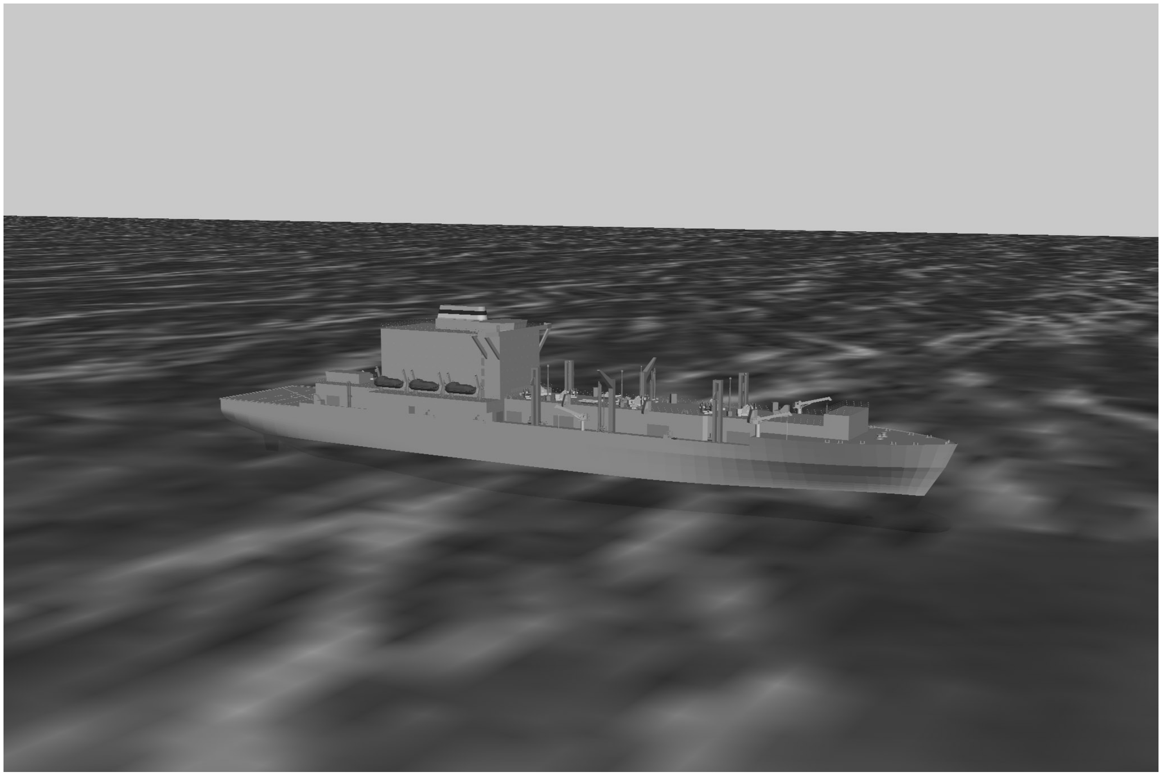
Flight I and Flight II DDG 51 class ships and the AN/SPY-1D radar are assessed to be operationally effective and operationally suitable. Some aspects of ship performance warrant improvement and/or additional testing. Although DDG 51 has demonstrated a robust hard-kill capability against most air threats, effectiveness against remaining identified threats should be examined as soon as the appropriate missiles and targets can be made available. Targets suitable for testing soft-kill effectiveness should be developed to complete the assessment of DDG 51 air defense effectiveness and support testing of other ship classes.

DDG 51's capability to defend against attacks from fast patrol boats has not received the level of attention warranted by the threat. Future testing should examine the ship's capability to counter realistic surface threats using all available weapons. The Gun Weapon System's effectiveness against light aircraft and helicopters should be evaluated during Flight IIA FOT&E. The ship's ability to defeat torpedoes should be re-tested as soon as technical developments warrant.

The Navy's investment in robust interoperability testing is already paying dividends. This effort has provided the first quantitative evaluation of unit and battle group situational awareness, and has established an interoperability baseline for the DDG 51 class. Testing has surfaced AEGIS system performance issues as well as inter-platform operability problems. Track correlation, ship gridlock, and target identification should receive special emphasis in light of deficiencies noted in OT-IIID. The wealth of test data will help point the way to problem resolution. Testing has also highlighted fleet training and doctrine shortfalls. The focus on interoperability must be sustained in future operational testing to evaluate Joint interoperability and assess the efficacy of computer program modifications made to address OT-IIID deficiencies.

DOT&E is concerned that funding for a second phase of land-based AN/SPY-1D(V) testing during FY03 may not be adequate to conduct a test that will provide the requisite risk-reduction.

AUXILIARY DRY CARGO SHIP (T-AKE 1)



Navy ACAT ID Program		Prime Contractor
Total Number of Systems:	12	TBD
Total Program Cost (TY$):	$4024.7M	
Average Unit Cost (TY$):	$335.4M	
Full-rate production:	N/A	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Auxiliary Dry Cargo ship program provides a new multi-product ship class to re-supply Navy combat forces at sea. The ships will replace the existing AFS- and AE-class ships and will provide ammunition, spare parts and provisions (dry, refrigerated and frozen). The primary mission of T-AKE 1 is to provide logistics lift from friendly ports or from specially equipped merchant ships to the battle group replenishment station ships. The T-AKE 1 will be capable of remaining on station with the battle group to fill the station ship role in conjunction with a T-AO-class ship.

The T-AKE 1 supports the ***Joint Vision 2020*** concept of ***focused logistics*** and enables the battle group missions of ***dominant maneuver*** and ***precision engagement***

BACKGROUND INFORMATION

By 2007, all of the Navy's 8-ship AFS-class and 8-ship AE-class will have reached their 35-year design life. A 12-ship T-AKE 1-class is intended to replace these ships, as recommended by the Navy study that serves as the Analysis of Alternatives for the program. The acquisition strategy, approved in April 1999 and subsequently somewhat modified, includes a single Contract Award Milestone (Milestone II-equivalent) DAB review in early FY01. At that time, the intention will be to award the detailed design and construction contract for the lead ship, with priced options for the next seven follow-on ships and not-to-exceed the established priced options for ships 9 through 12. Preliminary design studies conducted by potential ship builders have been completed, identifying innovative concepts for efficiencies with on-board material handling and cargo flow, and proposing life cycle cost savings by reducing manning and improving ship design. A Request For Proposals for the detail design and construction phase of the program was issued in February 2000, and the down-select to a single vendor is anticipated for January 2001.

TEST & EVALUATION ACTIVITY

During FY00, DOT&E has continued to participate actively in the program's working integrated product teams. Program immaturity has limited test planning to preparation of an initial Test and Evaluation Master Plan (TEMP) identifying operational issues and test events and objectives to support an evaluation of T-AKE 1's operational effectiveness and suitability. Concurrent development of the Operational Requirements Documents (ORD) and TEMP continued into FY00. This culminated with ORD approval in December 1999 and initial program TEMP approval in September 2000. However, as a condition for the approval of this TEMP, DOT&E had required that the TEMP be updated and approved prior to the Contract Award Milestone.

In FY99, DOT&E had re-confirmed the T-AKE 1 program designation as a Live Fire Test and Evaluation (LFT&E) oversight program. In FY00, the Navy and DOT&E developed the program LFT&E strategy. The details on implementing this strategy are being developed by the Navy and DOT&E for inclusion in the LFT&E Management Plan. The Management Plan, which is being developed, will describe the LFT&E program and support the waiver from Full-Up, System-Level testing. DOT&E approval of this plan is required prior to the single Milestone Decision. The most significant unresolved issues are associated with defining LFT&E testing requirements.

TEST & EVALUATION ASSESSMENT

The primary goal of the program, as stated in the draft ORD, is to provide effective underway replenishment capacity at the lowest life cycle cost; and, the ships are to be procured as an acquisition reform initiative utilizing commercial practices to the maximum extent deemed prudent. No formal operational testing or assessment is planned before the single FY01 Milestone decision to design and construct up to 12 ships over a seven-year period, but operational assessments are scheduled during the E&MD phase detail design activities. Operational assessment of the adequacy of cargo handling capability may require accreditation of modeling and simulation (M&S) by the Navy's Operational Test and Evaluation Force. To support this, DOT&E is working with the Navy to ensure that the TEMP contains adequate provisions for incorporating results of operational assessments into decisions affecting program execution, including design modifications determined to be required. This activity has not yet begun, and prompt action by the Navy is required to ensure that the operational assessment is adequate to detect inadequacies in cargo handling. Risks associated with flight operations for vertical replenishment must also be assessed. The required use of Navy standard replenishment rigging reduces risk associated with connected inter-ship replenishment operations. The major M&S concerns to DOT&E revolve around development of and the validation, verification, and accreditation of the modeling of a new contractor-produced intra-ship cargo handling system, which is unique to the design of this platform and vital for it to accomplish its mission. Since the ship hull will likely be based on an existing commercial design, the risk of serious hull and propulsion deficiencies during routine operations are less than the risk for cargo handling at sea. The anticipated TEMP update, required prior to the Contract Award Milestone in early FY01, will update and enhance the M&S program to conduct detailed design analysis and combined DT/OT.

The LFT&E management approach recognizes that the T-AKE 1 will to be built to commercial design standards while having resistance to underwater shock for a very limited number of systems. Recognizing that the issue is not how a system is designed but how it is employed, considerable work needs to be completed to characterize the shock resistance of commercial ship design features. Only limited information is available and little surrogate testing has been performed concerning the ability of a ship's hull structure and modern shipboard equipment, built to commercial standards, to withstand threat weapons effects from underwater shock and hull whipping. A logical starting point for developing an appropriate surrogate test program was a survey of available data on the response to weapons effects of ships built to commercial practice. DOT&E has articulated the importance of this issue, and the Navy conducted a survey. The Navy found that the data available are qualitative in nature and of limited use in developing a surrogate test program. The Navy has proposed a limited test program that focuses on answering T-AKE 1 critical LFT&E issues and fixing modeling weaknesses. The testing and analysis effort does not address perhaps the greatest area of concern for this ship: weapon-induced fires in the vicinity of fuel tanks and ammunition, either stored in magazines or staged for delivery.

CONCLUSIONS AND LESSONS LEARNED

The compressed acquisition strategy for T-AKE 1 provides no opportunity to perform a vulnerability assessment of the offeror's proposed contract designs in advance of the Single Milestone decision. As such, there is little opportunity for OT and LFT&E to affect the ship design. The first chance for LFT&E to affect the design came as a result of a vulnerability assessment of the Government's Point Design in September 2000. This assessment demonstrated the value of performing damage scenario-based engineering analyses of individual weapon attacks early in the acquisition process. As a result of this work, several recommendations were developed for improvement in the design. The Navy has agreed to perform a vulnerability assessment of the contractor's detailed design. However, the current schedule provides for the award of follow-on ships 2 through 4 before the completion of the detail design vulnerability assessment. It is likely, therefore, that only ships 5 through 12 will benefit from vulnerability assessment recommendations that involve hardware or equipment changes. The Navy has agreed to make changes as appropriate and cost effective.

CH-60S FLEET COMBAT SUPPORT HELICOPTER

Navy ACAT IC Program		**Prime Contractor**
Total Number of Systems:	237	Sikorsky Aircraft
Total Program Cost (TY$):	$4327.5M	
Average Unit Cost (TY$):	$18.26M	
Full-rate production:	1QFY02	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The CH-60S Fleet Combat Support Helicopter is the replacement for the current Navy CH-46D. The CH-60S is designed to provide the Navy's Combat Logistics Force with: (1) responsive vertical replenishment; (2) vertical onboard delivery; and (3) airhead support as well as day/night Amphibious Task Force search and rescue (SAR) services. Secondary missions include Special Warfare (overwater) Support (SWS), aeromedical evacuations, and noncombatant evacuation. A configuration of the CH-60S is also being designed to add the following missions: Combat Search and Rescue/Special Warfare (overland) Support (CSAR/SWS), Anti-surface Warfare (ASUW), and aircraft carrier plane guard/SAR. The addition of the Airborne Mine Countermeasures (AMCM) mission was approved on May 21, 2000. The multi-mission CH-60S supports the ***Joint Vision 2020*** operational concepts of ***focused logistics*** and ***full-dimensional protection***.

The CH-60S is an Army UH-60L Blackhawk airframe incorporating Navy Seahawk marinized GE T-700 engines, folding rotorhead and tail pylon, transmission/drive train, stabilator, and flight controls. The CH-60S will share, in part, with the Navy SH-60R helicopter a "Common Cockpit" which consists of multi-functional displays, keysets, and a complex client-server based tactical data processing system. The CH-60S avionics will include: (1) dual UHF/VHF transceivers; (2) inertial and Global Positioning System navigation; (3) night vision device-compatible heads-up displays; and (4) a ground proximity warning system. The aircraft will have provisions installed to incorporate a future CSAR mission kit consisting of tactical moving maps, FLIR with a laser range finder/designator, crew-served side suppression weapons, HELLFIRE missiles, forward firing guns/rockets, and an integrated self-defense system. The aircraft will also have provisions installed to incorporate AMCM sensors and destructors, individual programs that are currently in development.

BACKGROUND INFORMATION

The current CH-46D Navy helicopters are over 25 years old and a large fraction of them are nearing or have exceeded their original service life. An OA of the prototype CH-60S helicopter was conducted in response to a congressional mandate to demonstrate the concept of using a modified UH-60L Blackhawk to perform the Fleet Combat Support (HC) mission as a replacement for the aging CH-46D. The CH-60S ORD and TEMP were approved in April and May 1998, respectively.

Combined compliance testing (CT), developmental testing (DT), and operational testing (OT) was conducted from November 1997-January 1998 at Sikorsky's Stratford, CT facility and with the Combat Stores Ship, USS Saturn, 30 miles south of Long Island, NY. Each flight had either a DT or OT co-pilot, and a Sikorsky test pilot during the 45 hours flown. The OT portions of the tests were conducted in accordance with a DOT&E approved test plan as an early OA, and supported a May 1998 LRIP decision for initial production lots of the CH-60S. The assessment found the CH-60S to be potentially operationally effective and potentially operationally suitable for the HC mission. Due to the commonality of predecessor H-60 variants, the assessment was bolstered by historical data from Army and Navy files, where applicable.

The CH-60S has been designated a covered system for Live Fire Test under Section 2366, Title 10 U.S. Code. The finding that full-up live fire testing would be unreasonably expensive and impractical was made by USD(A&T) on July 8, 1998. An alternative LFT&E plan was approved at that time and Congress was notified. The plan is currently being updated to reflect the need for additional testing to accommodate the addition of the AMCM mission systems.

TEST & EVALUATION ACTIVITY

The U.S. Navy made the decision to develop and deploy an organic AMCM sensor system capability. The CH-60S was selected for the AMCM mission, and proof of concept testing commenced in August 1999 with the prototype CH-60S. Phase one testing, consisting of both static and dynamic pull tests, was successfully completed in December 1999. Phase two testing, consisting of dynamic tow testing of a representative shape, was successfully completed in January 2000. Phase two demonstrated single and twin-engine flight qualities, pilot workloads, and mission endurance. Phase three testing—consisting of all aspects of captive carriage, stream, tow, and recovery of the prototype AN/AQS-20 sonar system towed body—was completed in November 2000.

A revision to the ORD was approved on May 21, 2000 to add AMCM as a primary mission. A revision to the TEMP, which includes the AMCM mission, is in preparation and should be approved in 2QFY01.

The first flight of the first LRIP aircraft occurred on January 27, 2000, just days short of the Acquisition Program Baseline (APB) threshold. Late delivery of the aircraft to the Navy was caused by Common Cockpit technical development problems, late delivery of the systems, and immature software. The first flight supported a second LRIP decision, but schedule delays prompted internal program reviews that determined the need for a revised APB. The program was restructured to accommodate an additional 185-flight hours necessitated by the inability of the SH-60R program to conduct the majority of planned Common Cockpit testing. Schedule allowances were also made to provide sufficient time to prepare a final OPEVAL report and accommodate BLRIP report requirements.

TECHEVAL testing for the CH-60S Combat Support missions started in May 2000 and are scheduled to complete in January 2001. Successful TECHEVAL will support an LRIP-III decision. OPEVAL is scheduled to begin in early March and complete by the end of May to support a Milestone III decision in September 2001. The Navy's Helicopter Master Plan calls for the introduction of the AMCM mission configured CH-60S into the Fleet in CY05 and the CSAR mission configured CH-60S in CY06. Detailed development and test schedules are not yet available to support the introduction of these missions.

TEST & EVALUATION ASSESSMENT

The LFT&E strategy for the CH-60S required assessment of its combat survivability and potential for crew casualties, and included a recommendation of whether additional tests would be required. A panel of Navy, Army, and OSD experts convened in March 1999. Relevant Joint Live Fire and combat data for the H-60 series of aircraft were used to assess the survivability of the CH-60S. After the March 1999 meeting, the Naval Air Warfare Center conducted a component by component vulnerability assessment of the CH-60S using Navy mission scenarios. The Navy and DOT&E reviewed the assessment report and concluded that important data voids exist when employing the CH-60S in CSAR missions. DOT&E recognized that the identified data voids were common to other H-60 variants such as the Navy's SH-60R and the Army's UH-60L Upgrade, and proposed that the Army and Navy coordinate their efforts to fill the data voids so that the total LFT&E data requirement can be met at minimum cost. The Navy and the Army are preparing a plan whereby each Service will address some of the data voids and, taken together, all of the data voids will be addressed.

Both CT and DT testing to date have not demonstrated the maturity and stability levels expected of the initial versions of the Airborne Operations Program (AOP) software. The software integrates all flight controls, propulsion, navigation, and communications systems with the Common Cockpit flat-panel displays and keyset controls for the pilots. Future versions of AOP will integrate the weapons and self-defense systems required for the CSAR mission, as well as the five AMCM detection sensors and destructors. Although the AMCM systems are each ACAT II programs with their own individual ORD and TEMP, DOT&E intends to exercise operational test oversight of the integrated AMCM/CH-60S mission as an element of the CH-60S program. Two of the AMCM programs, Rapid Airborne Mine Clearance System and Airborne Mine Neutralization System, qualify as LFT&E covered systems for lethality and will be added to the master T&E oversight list during the next annual update.

RECOMMENDATIONS, CONCLUSIONS AND LESSONS LEARNED

Development and test of the Common Cockpit system has been a greater technical challenge than originally anticipated. Initial plans to test the bulk of the system during the first of two SH-60R DT and

OA periods adversely impacted the CH-60S test schedule due to SH-60R schedule uncertainty. Restructure of both programs transferred 185 additional flight test hours to the CH-60S program to enable sufficient TECHEVAL and OPEVAL on the Common Cockpit system in the CH-60S aircraft. Although additional flight test hours were provided, the unanticipated low level of flight software maturity continues to impose schedule risk on the overall CH-60S program.

The Navy and Army have not yet established a firm, fully funded, cooperative plan to conduct LFT&E to address OSD-identified data voids for the family of H-60 aircraft. Establishment of such a plan is necessary to control total cost and minimize the number of test articles subjected to destructive test.

COASTAL MINE HUNTER (MHC 51)

Navy ACAT IC Program

Total Number of Systems:	12
Total Program Cost (TY$):	$1730M
Average Unit Cost (TY$):	$143M
Full-rate production:	2QFY90

Prime Contractor

Intermarine USA & Avondale Shipyard

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The 12-ship Coastal Mine Hunter (MHC 51) program and an earlier program to construct 14 Mine Countermeasures Ships were initiated to replace minesweepers constructed in the 1950s. The mission of the MHC 51 is to detect, localize, identify, and neutralize current and future threat mines in littoral areas, harbors, and coastal waters worldwide. The MHC 51 is a vital part of ***dominant maneuver*** in maritime scenarios, contributing to both strategic and tactical mobility of naval and land forces. The MHC 51 also contributes to ***full-dimensional protection*** since naval mines inflict personnel and material casualties as well as deny freedom of action.

The design of the MHC 51 is based on the Italian LERICI class of mine hunters. Constructed of Glass-Reinforced Plastic (GRP), the ship is 188 feet long, has a beam of 36 feet, and displaces about 895 tons. Non-magnetic diesel engines drive cycloidal propellers. In another departure from conventional design, major machinery platforms are suspended from the main deck to provide acoustic isolation and shock dampening.

The combat system includes the AN/SYQ-13 Navigation, Command, and Control System; the AN/SLQ-48 Mine Neutralization System; the AN/SQQ-32 Minehunting Sonar; and .50 caliber machine guns.

BACKGROUND INFORMATION

The USS OSPREY (MHC 51) Shock Trial, consisting of five underwater explosions of progressively increasing intensities, was conducted at the Aberdeen Test Center in August-September 1995. This was the first U.S. Navy shock trial conducted on a ship with GRP hull and structure. The MHC 51 is also the largest composite monocoque hull ever built. Hence, there were many unknowns prior to the testing as to what its shock tolerance would be. Of note, the cradle arrangement used to suspend the propulsion diesel engines and electrical generators was successful in preventing damage to the cradle structure. The cradle arrangement was designed to address noise and vibration as well as shock. The Navy's Shock Trial final report was received by DOT&E in October 1998 and is addressed in the MHC 51 B-LRIP report.

The TEMP approved by DOT&E in 1995 called for a series of three operational tests. Two of the tests were to be conducted in 2QFY96 to evaluate minehunting effectiveness (OT-IIIA) and minesweeping effectiveness against moored mines (OT-IIIB). The second and third tests to evaluate the MHC 51's minesweeping effectiveness (OT-IIIB/OT-IIIC) were not conducted because the Navy cancelled plans to field modular minesweeping systems for the MHC 51. Shock trial preparations and post-shock repairs delayed the start of OT-IIIA to 2QFY97. OT-IIIA was completed aboard USS OSPREY and USS BLACK HAWK (MHC 58) in 1997.

FOT&E (OT-IIIB) was conducted aboard USS RAVEN (MHC 61) from March 1-16, 1999 to re-examine aspects of MHC 51 performance found deficient in OT-IIIA. Test operations included minehunting and mine neutralization in the shallow coastal waters near Panama City, FL, and in deeper water in the Gulf of Mexico. There were also several periods of testing conducted on the Coastal Systems Station instrumented range designed to measure the ship's magnetic and acoustic signatures and evaluate its susceptibility to bottom influence mines.

TEST & EVALUATION ACTIVITY

DOT&E completed an independent evaluation of OT-IIIB results and finalized the B-LRIP report, which was submitted to Congress in December 2000.

TEST & EVALUATION ASSESSMENT

Operational test of the MHC 51 class was conducted in accordance with test plans approved by DOT&E and, although not without limitations, was adequate to support an evaluation of operational effectiveness and operational suitability. Although most of the mine targets were uninstrumented mine shapes, they were sufficiently threat representative to support an evaluation of the ship's ability to detect, locate, identify, and neutralize mines under favorable environmental conditions. Lack of environmental variety precluded an assessment of minehunting effectiveness in areas with adverse conditions, such as a rocky bottom.

Targets capable of emulating the sensors and logic of threat mines and collecting data on ship-mine interactions were used to support evaluation of the ship's susceptibility to mines. These included Versatile Exercise Mine Simulators programmed to emulate specific threat mines in OT-IIIA and OT-IIIB. The test concept called for use of the Navy's Total Mine Simulation System (TMSS) to extend the limited live test results to other types of mines. However, TMSS failed to meet accreditation standards because of documentation deficiencies and discrepancies between M&S results and test observations. In particular, some of the mine fires predicted by TMSS did not occur during testing on the instrumented range. DOT&E believes, however, that the Navy's TMSS-based analysis of MHC 51 class mine susceptibility is sufficiently credible to be considered along with the results of operational testing and data from MHC 51 shock trials in order to evaluate MHC 51 class survivability.

As noted in previous annual reports, the ships tested during OT-IIIA were not operationally suitable because of unsatisfactory reliability and maintainability performance of the AN/SQQ-32 sonar and AN/SLQ-48 Mine Neutralization System and logistics support deficiencies. These factors, coupled with sub-par maintenance self-sufficiency caused by training and documentation deficiencies, resulted in below-threshold operational availability. Significant improvement was noted during OT-IIIB. The test ship and its combat systems demonstrated above-threshold performance in all aspects of suitability, and all maintenance was accomplished by the crew. This improvement was due, in part, to the Navy's efforts to enhance the reliability of the AN/SQQ-32 sonar. The shipboard availability of spares was below Navy supply system goals but did not adversely impact test operations.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

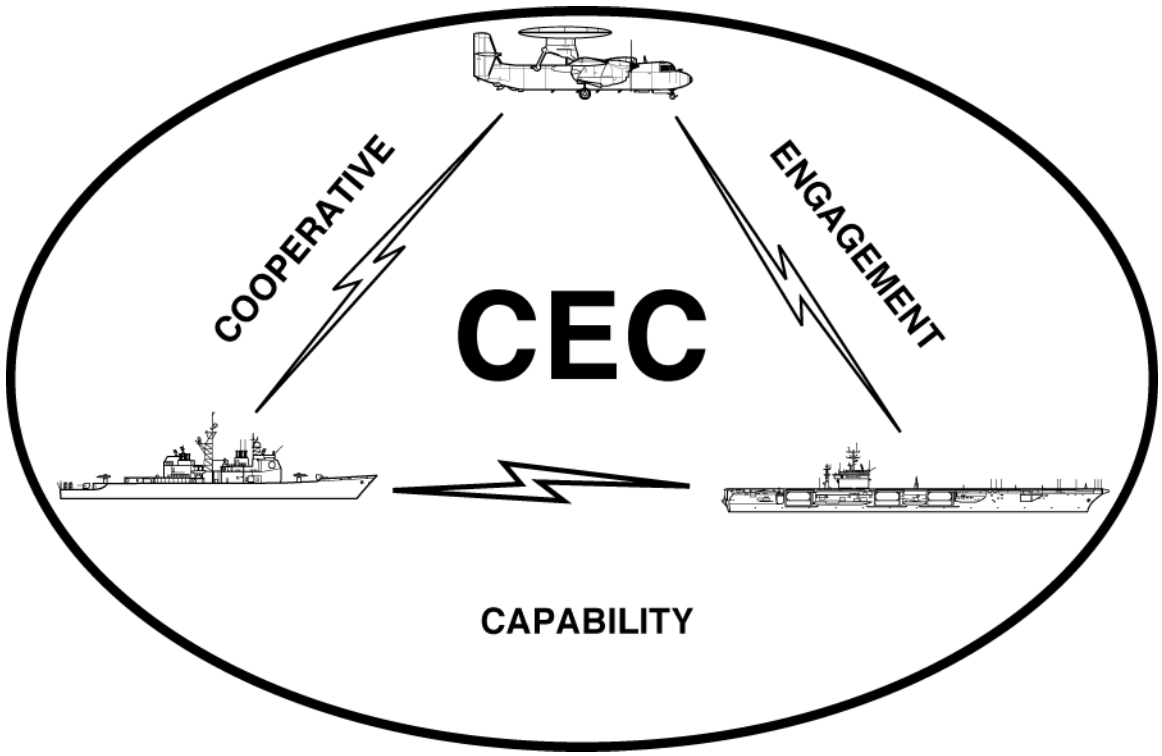
The MHC 51 class is operationally effective. Overall survivability is considered to be satisfactory because of the ship's low *susceptibility* to mines when operated in accordance with the Navy's current tactical guidance. However, *vulnerability* is unsatisfactory due to failure to meet the design keel shock factor during the MHC 51 Shock Trial.

The shock deficiencies are related to the GRP design and fabrication methods used for construction of the MHC 51 class. No remedies have been identified. Before embarking on any new acquisition program to construct GRP ships intended to go in harm's way, it would be prudent to conduct a robust RDT&E program to optimize material selection, structural design and fabrication methods and demonstrate improved shock hardness.

Efforts to refine and validate TMSS models should be continued to increase confidence in the resulting susceptibility analyses and fleet tactics. Susceptibility to mines in shallow water might be further reduced by incorporation of recent advances in degaussing system technology, such as closed-loop degaussing and continuation of ongoing initiatives to reduce radiated noise.

The operational suitability of the MHC 51 class is improving and is now considered satisfactory. Additional funding may be required to bring the shipboard availability of repair parts to desired levels.

COOPERATIVE ENGAGEMENT CAPABILITY (CEC)



Navy ACAT ID Program

Total Number of Systems:	215
Total Program Cost ((TY$):	$3,576.1M
Average Unit Cost (TY$):	$77.9M
Full-rate production:	FY02

Prime Contractor

Raytheon Systems Corporation,
St Petersburg, FL

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

Cooperative Engagement Capability (CEC) is a system of hardware and software that allows the sharing of radar data on air targets among ships. Radar data from individual ships of a Battle Group is transmitted to other ships in the group via a line of sight data distribution system (DDS). Each ship uses identical data processing algorithms resident in its Cooperative Engagement Processor (CEP), resulting in each ship having essentially the same display of track information on aircraft and missiles. An individual ship can launch an anti-air missile at a threat aircraft or anti-ship cruise missile within its engagement envelope, based on radar data relayed to it by another ship. Program plans include the addition of E-2C aircraft equipped with CEP and DDS to bring airborne radar coverage plus extended relay capability to CEC. CEP-equipped units, connected via the DDS network, are known as Cooperating Units (CUs).

As currently implemented, CEC is a major contributor to the ***Joint Vision 2020*** concept of ***full-dimensional protection*** for the fleet from air threats. In concert with multi-Service sensor and engagement systems, it can contribute to a major expansion of the battlespace.

BACKGROUND INFORMATION

An at-sea demonstration of CEC was conducted during FY90. An early operational assessment was conducted in FY94 based on results of at-sea developmental testing, including missile firings at the Atlantic Fleet Weapons Training Facility in Puerto Rico. Although there were significant test limitations, we concluded that CEC is potentially operationally effective and potentially operationally suitable. We also observed that this assessment must be tempered with the caveat that CEC has not undergone OT&E with the attendant operational realism. Approval to begin EMD (Milestone II) was granted in May 1995. An additional early operational assessment (OT-1A) of the airborne component of the CEC network was conducted in September 1995. In accordance with congressional guidance, the Navy certified IOC for CEC (engineering development model equipment upgraded to AN/USG-1) in late FY96.

OT&E to support the initial LRIP decision of AN/USG-2 equipment was conducted in August 1997. Although CEC was assessed as being potentially operationally effective and potentially operationally suitable, significant problems were observed in Battle Group interoperability and in software reliability. Interoperability problems experienced in early 1998 at-sea testing with the latest Aegis Weapon System software involved CEC, as well as the Aegis Weapon System, ACDS Block 1, and the command and control processor for the tactical data links. Deficiencies were in the areas of track management, net operations, cooperative engagement, engagement support, composite identification, and link interoperability. This resulted in freezing the CEC software configuration (Baseline 2) and decelerating CEC development so that associated system software (Aegis Weapon System (AWS) Baseline 6.1 and Advanced Combat Direction System (ACDS) Block 1) could reach maturity. An important lesson from this was that CEC is but one element of a larger system of systems, with the proper integration of elements essential for operationally effective and suitable operation. As a result, the PEO implemented an analytical and management structure to examine test data from the major sub-systems: AWS, ACDS Block 1, CEC, and the tactical data link command and control processor. Through collaborative analysis between the major sub-system teams, rapid feedback was provided to a senior system engineering council that made recommendations to the PEO regarding software modifications to enhance overall system performance. In addition, the Naval Sea Systems Command initiated the definition of battle force level interoperability requirements.

The re-planned program, challenged by the requirement to synchronize testing with fleet deployment schedules, included four at-sea test periods in 2000, followed by TECHEVAL and OPEVAL in 2001. The full production decision is expected during 1QFY02.

TEST & EVALUATION ACTIVITY

An OA of CEC (AN/USG-3 equipment) installed in an E-2C aircraft was conducted in October 1999. The two periods of testing included operations first with the two land-based test sites at Wallops Island and Dam Neck, VA, followed by CEC network operations with an Aegis Baseline 5.C cruiser. A P-3 aircraft, modified to emulate an E-2C, participated in both periods. The AN/USG-3 allowed integration of the E-2C surveillance radar and Identification Friend or Foe (IFF) sensor into CEC networks. The OA was conducted in accordance with a DOT&E-approved test plan and TEMP.

The first underway period to examine software modifications to CEC, Aegis Baseline 6.1, ACDS Block 1, and C2P as a result of the 1999 test-analyze-fix iteration, was in February 2000 in the Virginia

Capes area. These were engineering tests. Participants included an Aegis Baseline 6.1 cruiser, a CEC-equipped P-3 aircraft, the land-based test site at the Ship Combat Systems Center, Wallops Island, VA, the land-based test site at Dam Neck, VA, and the relay tower at Eastville, VA. Tracking runs were conducted with aircraft and target drones. EA against radars was used during several tracking tests. Tests were conducted with CEC, both on and off, for comparison. During this underway period and each of the following, a non-CEC Aegis destroyer participated to examine CEC effects on the tactical data link of the non-CEC participant. In December, two non-CEC Aegis destroyers participated.

Developmental testing (DT-IIE) was conducted in May 2000 at the Atlantic Fleet Weapons Training Facility in Puerto Rico. Participants included two Aegis Baseline 6.1 cruisers and aircraft carrier with ACDS Block 1 and two CEC-equipped aircraft, and a relay station at Crown Mountain, St. Thomas, Virgin Islands. Tracking runs were conducted with aircraft and target drones. Tests were conducted with CEC, both on and off, for comparison. EA was conducted against both shipboard radars and the DDS network. Six Standard Missiles and one Sea Sparrow missile were fired at target drones representing anti-ship cruise missiles. Testing was observed by DOT&E staff.

DT-IIF/OT-IIA3 was conducted in late September 2000 in the Virginia Capes operating area with two Aegis Baseline 6.1 cruisers, two Aegis Baseline 5.C cruisers, USS WASP (ACDS Block 1), and USS EISENHOWER (ACDS Block 1) from pierside in Norfolk, VA. The two land-based test sites (Wallops Island and Dam Neck), connected by the Eastville, VA relay tower, were participants, as were two CEC-equipped aircraft (E-2C and a P-3 that was equipped with an E-2C surveillance radar). Tracking runs were conducted with aircraft. EA was conducted against ship radars. OT was conducted in accordance with a DOT&E-approved test plan and TEMP, although a combination of target drone control problems, interference by boats, and bad weather effects resulted in none of the planned missile firings being conducted. Testing was observed by DOT&E staff.

DT-IIG was conducted in December 2000, both at the Atlantic Fleet Weapons Training Facility in Puerto Rico and in the Virginia Capes operating area. Participants in the Puerto Rico phase included the four cruisers that were in the previous DT/OT, one CEC-equipped aircraft equipped with CEC, and a CEC node at St. Thomas. In the Virginia Capes area participants were the four cruisers, the two land-based test sites, two CEC-equipped aircraft, and two ACDS Block 1 ships: USS KENNEDY and USS WASP. Extensive tracking runs were conducted against aircraft and target drones. EA was conducted against ship radars. Standard Missiles and Sea Sparrows were fired at target drones. Two non-CEC Aegis destroyers participated in the exercise. Testing was observed by DOT&E staff.

TEST & EVALUATION ASSESSMENT

The February 2000 engineering test was the first opportunity to examine the full functionality of the software planned to support the OPEVAL. The test demonstrated the overall soundness of the software changes that had been made, and revealed several additional changes required to meet the original performance goals. Comparisons between combat system performance without CEC (DDS not transmitting), and performance with CEC, indicated improvement in the overall tactical picture when CEC was contributing. Although Link 16 (TADIL J) interoperability remains a significant challenge (consistent with current fleet operational experience), the test showed CEC contribution to improving Link 16 accuracy and improved Link track number stability. Incorrect IFF association to radar tracks was also reduced, leading to improved ID accuracy.

The May 2000 developmental testing (DT-IIE), conducted in Puerto Rico, included operationally realistic scenarios along with others that focused on verification that computer program changes operated correctly. Analysis indicated that operational issues were also improving and thresholded requirements were successfully demonstrated. The intended testing of force interoperability peformance was incomplete because of some data collection failures and a ship navigation data failure, but the partial results indicated that CEC improved overall force tracking correctness.

The September 2000 combined developmental and operational testing (DT-IIF/OT-IIA3), conducted in the Virginia Capes operating area, brought to the CEC net both the largest number of cooperating units yet tested and the largest number of air tracks encountered during testing. Tracking runs were conducted with aircraft and EA was conducted against ship radars, but a combination of target drone control problems, interference by boats, and bad weather effects resulted in none of the planned missile firings being conducted. Notwithstanding the lack of missile firings, much was learned in the areas of network stability, track identification, CEC tracking, and display system limitations. Software fixes were put in place to correct deficiencies observed during the September testing, in preparation for the next testing in December.

The December 2000 developmental testing (DT-IIG) was conducted in two phases. The first phase was with four Aegis cruisers conducting tracking exercises and Standard Missile firing exercises at the Atlantic Fleet Weapons Training Facility sea range at Roosevelt Roads, Puerto Rico. A P-3 aircraft, modified to emulate an E-2C Hawkeye airborne early warning aircraft, participated in the CEC network as did a land-based site located on St. Thomas. Both actual and simulated missile firings were conducted against targets that simulated high-altitude as well as sea-skimming enemy anti-ship cruise missiles. For the second phase, the four cruisers joined an aircraft carrier and an amphibious warfare ship on the way to the Virginia Capes operating area to conduct testing with a larger CEC network and in an area of greater air track density. Participants in the second phase also included two airborne early warning aircraft and two land-based test sites located at Wallops Island and Dam Neck. A problem observed during both DT-IIG and the preceding DT-IIF/OT-IIA3 was the proliferation of incorrectly identified air tracks (identified as friendly). Intensive examination of the data is underway, as analysts seek to understand and isolate root causes of this and other performance-detracting problems observed during at-sea testing, and recommend modifications to improve performance during TECHEVAL and OPEVAL. Ship crews received valuable training in preparation not only for the technical and operational evaluations, but also for the ensuing deployment of the battle group.

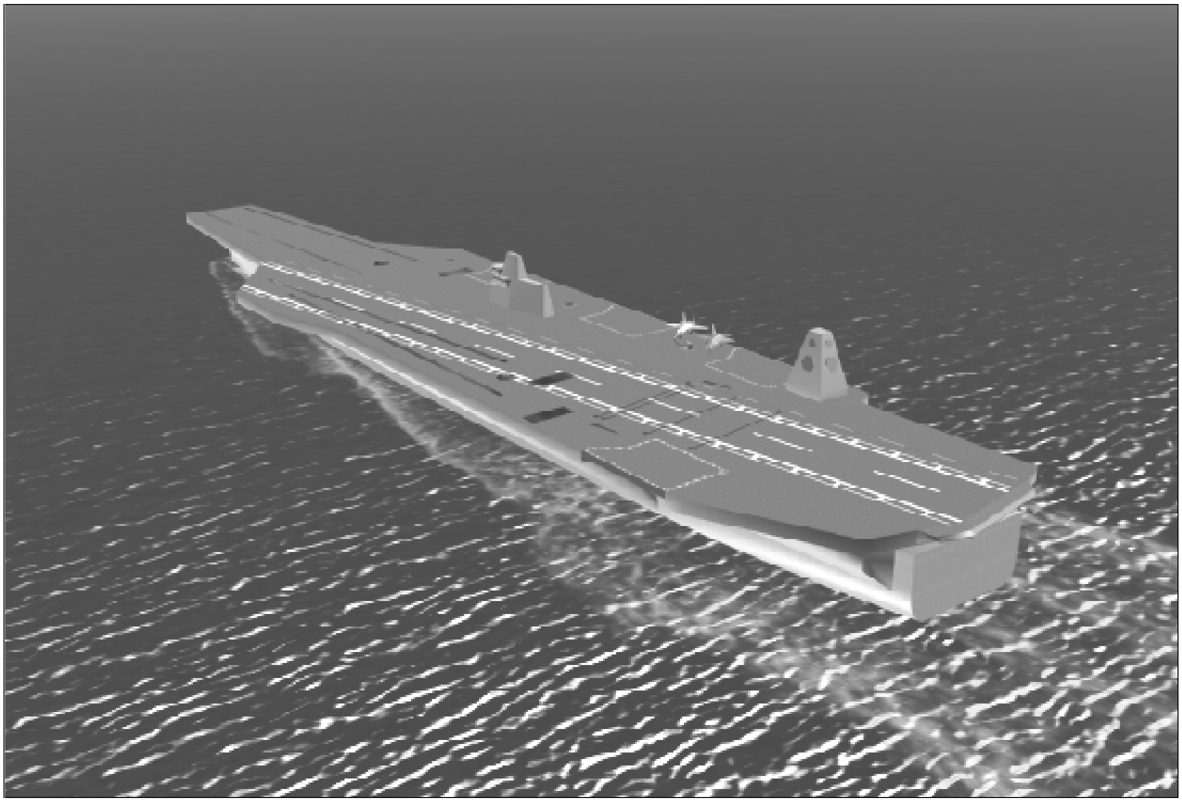
CONCLUSIONS

The several underway periods were key to preparing the overall system for OPEVAL in FY01. The system was subjected to a regimen of testing with increasing complexity as the year progressed. Each underway testing period was followed by a focused period of analysis, determination of whether further software modifications were required, and rapid implementation of those that were required prior to the next underway period. Testing to date has indicated improvement in interoperability and overall performance of CEC, but the realism attained during the early testing and the duration of the more operationally realistic testing have not been sufficient to conclude with high confidence that most operational problems have been identified.

Synchronization of OPEVAL with fleet deployment schedules remains a challenge. This is due in part to the requirement to have an adequate number of ship CUs. From an OT&E perspective, ensuring that enough CUs participate in the CEC net during end-to-end (detection through intercept of targets representing anti-ship cruise missiles) testing is critical to achieving a realistic environment for operational evaluation of this complex system prior to its delivery to fleet operators. This is a test adequacy issue that is among the key drivers for the OPEVAL.

This "system of systems" using different ship classes and aircraft is replete with interoperability challenges as well as the potential for significant progress toward realization of a single integrated air picture for Battle Group units. The interoperability challenges are the major obstacles, and the Navy is addressing them impressively, as evidenced by their significant commitment of ships, aircraft, land-based test sites and other resources during multiple at-sea periods of testing. The collaborative assessment process and the system of rapid feedback, based on testing results regarding software design changes, are working. Additionally, the Navy has implemented an effort to develop appropriate fleet tactics, techniques, and procedures to mitigate persistent deficiencies in the CEC-equipped battle groups and maximize the effectiveness of the new capabilities. Indeed, this PEO's overall approach could establish a pattern for emulation by other acquisition managers challenged with the development and delivery of complex, highly interactive "systems of systems" that cut across PMs, PEOs, Systems Commands, and other organizational boundaries.

CVN(X)



Navy ACAT ID Program
Total Number of Systems: TBD
Total Program Cost (TY$): TBD
Average Unit Cost (TY$): TBD
Full-rate production: N/A

Prime Contractor
Newport News Shipbuilding

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

CVNX is a new class of nuclear-powered, large deck aircraft carriers. With an expected 50-year life cycle, the first ship (CVNX1) will be a part of the fleet through at least 2063 and with its new warfare system, it will be a major factor in achieving ***information superiority*** for the ***dominant maneuver*** force of tactical naval aviation. Using an evolutionary approach to acquisition, current plans call for incorporation of major elements of a new integrated warfare system, including a new Multi-Function Radar (MFR) and Volume Search Radar (VSR) in CVN77 to ensure ***precision engagement*** of enemy forces. Newport News has selected Lockheed Martin Corporation to be the CVN 77 Electronic Systems Integrator that will ultimately be included on CVNX.

CVNX1 will have a Nimitz class hull with an upgrade of the CVN77 weapon system, new reactor and propulsion plant design, and greatly increased electrical power generating capacity. If technologically feasible, this ship will have an Electro-magnetic Aircraft Launching System (EMALS) that will replace the steam driven catapults of earlier aircraft carriers. This decision will be made in FY02.

CVNX2 will incorporate a new Electromagnetic Aircraft Recovery System (EARS) and other new technologies along with flight deck design changes. EARS also includes service life growth margins while reducing manpower requirements and total ownership costs.

BACKGROUND INFORMATION

The Navy's evolutionary approach to acquisition of a new aircraft carrier was approved by OSD in a June 15, 2000 Milestone I decision, following an extensive Analysis of Alternatives (AOA) concerning potential approaches and designs. Part 1 of the AOA, performed in 1997, focused on the carrier air wing composition and size, selecting an 80-plane air wing. Part 2 of the AOA was completed in October 1998, which selected the Nimitz hull for CVNX1 with evolutionary improvements in CVNX2 and follow-on ships. Part 3 of the AOA ended in January 00 where 6 new designs and 8 modified CVNX1 designs were analyzed before selecting concepts that will affect CVNX2. Milestone II is scheduled for Apr 02 and construction of CVNX1 is set to begin in 2006.

TEST & EVALUATION ACTIVITY

This year's T&E activity focused on preparation of the Milestone 1 Test and Evaluation Master Plan in parallel with development of the Operational Requirements Document. Consistent with the emphasis on early program involvement, DOT&E and OPTEVFOR representatives were active participants in the T&E Integrated Product Team (IPT) charged with TEMP preparation as well as the Integrating IPT that addressed overarching acquisition program issues.

In the Live Fire Test and Evaluation area, the Navy delivered a draft of the Milestone I Vulnerability Assessment Report (VAR) to DOT&E for review in May 2000. The assessment, the first in a series of six VAR's, was a summary of the survivability work accomplished for the Analysis of Alternatives. DOT&E submitted its questions and proposed changes to the Navy for incorporation into the final version of the VAR, scheduled for completion in early FY01.

TEST & EVALUATION ASSESSMENT

The Milestone 1 TEMP includes an Early Operational Assessment (EOA) that will commence in 2001 to evaluate the CVNX1 preliminary design. A diverse team comprised of OPTEVFOR test directors, subject matter experts from Navy Systems Commands (laboratories and field activities), and user representatives from the fleet will perform this EOA. The team will examine ship design documentation and the results of all applicable testing performed by the shipbuilder and system developers. The team will pay special attention to DD21 Program technologies that are candidates for insertion beginning with CVN77 and to the progress of Electro-Magnetic Aircraft Launching System (EMALS) testing. Since CVNX will evolve from the Nimitz design, the team will assess whether deficiencies in the current design are being addressed to the satisfaction of the fleet.

Although the mature Nimitz class aircraft carrier program has not been under active oversight in recent years, DOT&E has signaled special interest in the CVN77 warfare system. If the CVN77 warfare system proves to be a precursor of the CVNX warfare system as currently planned, DOT&E and

OPTEVFOR will closely monitor all relevant contractor and developmental testing. OT will be conducted at appropriate land-based test facilities and aboard CVN77 following delivery.

Regarding LFT&E, and since CVNX1 will be built using a Nimitz class hull, DOT&E believes that an assessment of the known vulnerabilities is critical to minimizing the vulnerabilities of CVNX. The draft Milestone I VAR, however, presented no data on Nimitz class vulnerabilities, even though CVN 76 was the baseline design for the Analysis of Alternatives. Furthermore, the VAR failed to establish that the survivability of any of the design alternatives was better or worse than the Nimitz class ships currently in service and in production. In comments and questions provided to the Navy, DOT&E has asked that this comparison between CVN 76 and CVNX design alternatives be made. Director, Strategic and Tactical Systems, and DOT&E, in a memorandum approving the TEMP, stated that the Navy should program adequate resources to design CVNX to counter current and future underwater threats, and evaluate them prior to Milestone II.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

DOT&E endorses the level of early OT community and user involvement associated with the Early Operational Assessment (EOA) that will be conducted in 2001 and 2002. This important, independent evaluation will afford an early opportunity to identify and correct any significant shortcomings in the CVNX1 design and reduce the requirement for costly changes during the construction process.

CVNX depends on technology advances pursued in DD21, particularly with regard to the new warfare system and associated radar. Any slide in the DD21 program will have repercussions on CVNX.

DEFENSE INTEGRATED MILITARY HUMAN RESOURCES SYSTEM (DIMHRS)

Navy ACAT IAM Program		**Prime Contractor**
Total Number of Systems:	TBD	TBD
Total Program Cost (TY$):	$437M	
Average Unit Cost (TY$):	TBD	
Initial Operating Capability	TBD	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The objective of the Defense Integrated Military Human Resources System (DIMHRS) is the automation and integration of personnel and pay entitlement business processes into a standard single point of entry system that will collect, pass, use, and report personnel and pay entitlement data. DIMHRS will provide a fully integrated military personnel and pay system for all components of the Military Services. It will replace 17 legacy systems, including all currently operating Service-specific pay and personnel systems. It is being developed based upon COTS applications. Extensive re-engineering of business practices that captures the best of both private and public sectors are expected.

The initial core system of DIMHRS will provide support to core processes that are common to all Services. This core system shall collect, store, pass, process, and report personnel and pay data for all DoD Active Duty, Reserve, Guard, and retired personnel. DIMHRS will support the responsibilities and requirements of the individual Military Service Departments and, in time of war, the Coast Guard. Common software and data bases are the foundation of DIMHRS.

The Services will retain their structure management command and control functions to ensure personnel operational readiness. Personnel and pay organizations will use DIMHRS at all echelons of command to support personnel and pay functions. DIMHRS data will also be used by managers and analysts in the OSD, the Joint Staff, and other federal agencies for planning and reporting purposes. DIMHRS supports ***information superiority*** envisioned in ***Joint Vision 2020*** by providing a seamless integration of military personnel and pay information within the Defense Department.

BACKGROUND INFORMATION

DIMHRS was conceived to address deficiencies impacting the personnel and pay entitlement support provided to military commanders. Approved in 1998, the Joint Requirements Oversight Council (JROC)-approved Mission Needs Statement identified the following five requirements that DIMHRS must address:

- Provide Commanders-In-Chief with accurate and timely personnel data needed to assess operational capabilities.
- Employ standard data definitions across Services.
- Correctly track mobilized reservists.
- Provide accurate personnel tracking into and within a theater of action.
- Simplify data entry, system maintenance, and resolution of pay discrepancies.

The initial acquisition strategy developed by the PMO was flawed, and the strategy was suspended pending review by the Joint Requirements and Integration Office under the Office of the Under Secretary of Defense for Personnel and Readiness. This issue remains unresolved and the program office is somewhat hampered in their efforts to plan and execute the development of DIMHRS.

TEST & EVALUATION ACTIVITY

The PMO has held several Test and Evaluation Integrated Process Team meetings. DOT&E reviewed and approved a preliminary DIMHRS TEMP in June 2000.

TEST & EVALUATION ASSESSMENT

There have been no test events subject to DOT&E assessment.

E-2 AIRBORNE EARLY WARNING (AEW) HAWKEYE 2000

Navy ACAT ID Program		**Prime Contractor**
Total Number of Systems:	75	Northrop-Grumman – Platform Integrator
Total Program Cost (TY$):	$2.4B	Johns Hopkins – CEC and ACIS Software
Average Unit Cost (TY$):	$320M	Raytheon Systems – CEC Hardware
Full-rate production:	2QFY01 (MCU)	Lockheed-Oswego – ESM
	2QFY04 (CEC)	Raytheon and Compaq – MCU
MCU OPEVAL:	1QFY01 –2QFY01	Allied Signal – 15 ton Vapor Cycle

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

Hawkeye 2000 is an umbrella term for multiple improvements to the Group II E-2C. Multiple contractors working as a team, each responsible for separate improvements, compound the challenges of conducting OT&E. These improvements include the addition of: (1) an upgraded inertial navigation system, (2) an environmentally friendly and higher output 15-ton Vapor Cycle system, and (3) Ultra-High Frequency (UHF) Satellite Communications (SATCOM). They also include the replacement of the: (4) current mission computer with commercial-off-the-shelf computer (Mission Computer Upgrade [MCU]); (5) three control and display consoles with commercial-off-the-shelf workstations (Advanced Control Indicator System [ACIS]); and (6) current AN/ALR-73 Passive Detection System with an Electronic Support Measures (ESM) system; as well as (7) integration of the airborne variant of the Cooperative Engagement Capability (CEC) system; and (8) development of a Mission Information Transfer System

(MIST). Additionally, the program office is replacing the current four-blade propellers with eight-blade propellers.

The deployable, carrier and land-based capable Hawkeye 2000 E-2C, with its family of onboard sensors, multiple voice and data links, and decision maker support systems provide *mobile*, *agile*, and *dispersed* **Command and Control**. The effective integration of Link 11/TADIL A, Link 16/TADIL J, and CEC into the Hawkeye 2000 provide **interoperability** required for **Joint and Multinational operations**.

BACKGROUND INFORMATION

Hawkeye 2000 is the most recent of a series of modifications aimed at improving the capability and sustainability of the E-2C, making it a powerful C2 tool in support of ***information superiority, precision engagement,*** *and* ***dominant maneuver***.

E-2C improvement modifications will occur incrementally, not in a block upgrade. The modifications will be incorporated into new E-2C aircraft production (approximately four annually) and will be retrofitted into older E-2C aircraft, if funding becomes available.

The key objective of the CEC modification is to provide the Navy with an airborne sensor and relay to extend the surface-based coverage. The airframe was modified to carry the CEC antenna under the center fuselage (see photo), the liquid cooling system for the AN/APS-145 surveillance radar was modified to support CEC coolant needs, and the current vapor cycle system was replaced with a higher output system to support the increased environmental control requirements of the new modifications.

In order to accommodate CEC hardware, the E-2C required increased mission computing and display capabilities, as well as an offset in weight and volume to carry the estimated 600-700 pound CEC equipment. The replacement of the analog computer with the MCU and the display stations with the ACIS provided the majority of the needed weight savings, computing, and display capabilities.

The UHF SATCOM modification relocates the current UHF SATCOM, which is currently voice-only, and adds the connectivity required to receive data and products but does not include the processing required to support display of data products on the ACIS. The ESM system, a derivative of the AN/ALQ-210 being developed for other platforms, replaces the current Passive Detection System, which is no longer available. The new ESM is only required to provide the same functionality as the system it is replacing. It is expected that the new ESM system will need less operator intervention, provide improved identification and display of data as well as increased reliability.

Both MCU and ACIS are also expected to support mission improvement capabilities beyond Hawkeye 2000.

TEST & EVALUATION ACTIVITY

The Annex A, E-2C CEC Modification to the CEC TEMP was approved in October 1999. The Hawkeye 2000 MCU TEMP was approved in July 2000.

The MCU modification, which completed software Formal Qualification Test in May 2000, entered Technical Evaluation (TECHEVAL) in July 2000, which will be followed by Operational Evaluation (OPEVAL) in October 2000. Commander, Operational Test and Evaluation Force presented a Test Concept briefing in 1999 and updated it in July 2000. The Test Plan is expected to be submitted for DOT&E approval during August 2000.

The CEC modification completed Developmental Test (DT) Phase I of flight testing in February, with 110 separate Hawkeye 2000 CEC flights (mostly in support of surface CEC testing); the program office used those flights to get information on the performance of the entire airborne system. These flights were flown by the only CEC-modified test E-2C aircraft and included CEC capable Land-Based Test Sites (LBTS), Lear Jet air targets, and leveraged surface ship CEC test events. A DT flight Phase I test message was released by the Naval Air Warfare Center.

Commander, Operational Test and Evaluation Force (COTF) completed OT-IIA-2, an OA of E-2C CEC in October 1999. DOT&E approved the OT-IIA-2 Test Plan in September 1999 and COTF provided a test report in March 2000. During the E-2C CEC OT-IIA-2, the CEC modified E-2C flew five missions for a total of 23.6 hours in the Virginia Capes area. The E-2C exchanged CEC information with two LBTS for all five missions and with two AEGIS Guided Missile Cruisers (CG) on the last mission day. The E-2C flew patrol orbits designed to provide airborne relay and extend Battle Group air surveillance coverage. Contract Lear Jets flew adversary aircraft and anti-ship missile profiles while the E-2C, on one mission, controlled F-15 aircraft as defensive Combat Air Patrol.

An operational E-2C squadron, VAW-117, has been designated as the MCU/ACIS modification OPEVAL squadron, and has received four E-2C aircraft modified with Low Rate Initial Production MCU and ACIS sub-systems. The squadron is employing the aircraft in normal operational training, exercise, and aircraft carrier deployment work-up flights.

During January and February 2000, three of VAW-117's MCU/ACIS equipped E-2C aircraft participated in the All Service Combat Identification Evaluation Team (ASCIET) 2000 event. The E-2C operated from Hunter Army Airfield in Savannah, GA, and flew 20 airborne early warning and fighter control missions overland and overwater. The E-2C provided air intercept control to USAF F-16, USN F-14D and F/A-18, and Royal Air Force Tornado F1 fighter aircraft. It also exchanged tactical information with a number of platforms including the E-3 Airborne Warning and Control System (AWACS), the Marine Tactical Air Operations Center, the Army Patriot Information and Coordination Central, a Navy AEGIS Guided Missile Destroyer, and a Royal Navy Frigate. While impressions about the overall performance were positive, the formal results (after-action report and briefing) were not available at the time this report was published.

TEST & EVALUATION ASSESSMENT

The Phase I E-2C CEC DT flight effort generated 202 deficiency reports—52 were Part I (Critical). Iterations of CEC, vapor cycle, MCU, and ACIS hardware, software, and firmware steadily reduced the number of open deficiencies by the end of the Phase I flight test to six Part I. These six include CEC data relay and five air tracking related deficiencies.

The E-2C CEC OA demonstrated that the E-2C was able to enter CEC networks, and provide and relay sensor data with other CEC capable LBTS platforms and AEGIS surface combatants. The ACIS workstations were very reliable (100 percent) during the OA. The development and integration is still immature, and improvements in Battle Group interoperability air track manipulation, CEC subsystem reliability, MCU, and vapor cycle stability are still needed before OPEVAL. The COTF evaluation was "potentially" operationally effective and suitable."

While not a test, the participation of VAW-117 MCU-equipped E-2C aircraft at ASCIET 2000 provided valuable opportunity to assess the maturity of the MCU and ACIS in an operational environment. The E-2C's Link 16 interoperability to exchange air surveillance information demonstrated and indicates reduced risk for this feature for operational test.

LESSONS LEARNED

Modifications to existing systems, even when replacing an earlier but like functionality (especially with simultaneous multiple improvements) with an upgraded version, must be evaluated in an operationally realistic manner against valid or revalidated requirements. Testing must be supported by updated, coordinated, and approved TEMPs. If not, unintended impacts to other onboard systems may go unrecognized until deployment. Additionally, the fleet user, the Battle Group Commander, and Theater CINC will not be alerted to enhancements and limitations to their command and control capabilities imposed by these modifications.

Participation in exercises, such as ASCIET, even while in Developmental Test, provides valuable insight into risks and opportunities for operational test. Developers should be encouraged to participate where possible, and OTAs should monitor these exercises to collect data and encourage innovation and experimentation. This effort will help the developer learn what needs to be corrected.

Robust and credible DT flight testing can reduce OT effort and resources needed, refine needed training, increase confidence in results, and indicate areas of risk for both the developer and OTA. This was confirmed when the findings from the E-2C CEC OA were consistent with the results experienced in Phase I DT testing.

EA-6B UPGRADES

Navy ACAT II Program		Prime Contractor
ICAP-III:		Northrop Grumman
Total Number of Systems:	123	
Total Program Cost (TY$):	$1.195B	
Average Unit Cost (TY$):	$5.06M	
Full-rate production:	3QFY03	
BLOCK 89A:		Government
Total Number of Systems:	119	Major subcontractor: Northrop Grumman
Total Program Cost (TY$):	$518.2M	
Average Unit Cost (TY$):		
BLK 82 (46 kits)	$3.3M	
BLK 89 (39 kits)	$1.3M	
Full-rate production:	4QFY99	
BAND 9/10 TRANSMITTER:		BAE Systems
Total Number of Systems:	209	
Total Program Cost (TY$):	$109.4M	
Average Unit Cost (TY$):	$524K	
Full-rate production:	1QFY97	
LOW BAND TRANSMITTER (LBT):		BAE Systems
Total Number of Systems:	180	
Total Program Cost (TY$):	$189.6M	
Average Unit Cost (TY$):	$900K	
Full-rate production:	1QFY04	

USQ-113 (V3) COMMUNICATIONS JAMMER: Lockheed Martin - Sanders

Total Number of Systems:	119
Total Program Cost (TY$):	$30.2M
Average Unit Cost (TY$):	$253.7K
Full-rate production:	FY96

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The EA-6B "Prowler" aircraft contributes to the ***Joint Vision 2020*** concept of ***full-dimensional protection*** and ***precision engagement*** by improving supported aircraft probability of survival through its contribution to the Suppression of Enemy Air Defenses (SEAD) Electronic Attack (EA) mission. Planned improvements also contribute to ***focused logistics*** by providing improved built-in-test capabilities to allow confidence in system readiness by maintenance personnel and system health by the aircrew.

The EA-6B is a four-seat, all weather, twin turbojet powered, tactical EA aircraft designed to operate from aircraft carriers and airfields ashore. Its primary mission is the interception, analysis, identification, and jamming of enemy weapons control and communications systems in support of joint offensive and defensive operations. High priority EA missions include SEAD by denying, delaying, degrading, or destroying the enemy's ability to detect and target friendly forces. The crew includes one pilot and three electronic countermeasures officers. The EA-6B carries the AN/ALQ-99 Tactical Jamming System (TJS). The TJS on-board system (OBS) includes the receiver, processor, and aircrew interfaces. The TJS also includes a selection of mission-configured jammer pods carried as external stores. Each jammer pod contains a ram air turbine generator, two selectable transmitter modules with associated antennas, and a universal exciter that is interfaced with and controlled by the OBS and aircrew. The modular open architecture of the jammer system optimizes transmitters and antennas for a given frequency range and tailors mission configurations. The EA-6B also has the USQ-113 Communications Jammer and may be armed with high-speed radiation missiles (HARM) for enemy surface-to-air radar destruction and suppression.

BACKGROUND INFORMATION

Operational since 1972, the EA-6B has undergone a number of upgrades: Expanded Capability, Improved Capability (ICAP), and Improved Capability II (ICAP II). ICAP II, including major upgrades to HARM employment and updated communications, was installed on operational aircraft in Operation Desert Storm. Another significant upgrade, Advanced Capability (ADVCAP), reached Full Scale Development in FY93 but was dropped from the FY95 Navy budget submission and subsequently cancelled. IOT&E of ADVCAP was completed in 1QFY94. This program provided the technical basis for much of the current upgrade program. ADVCAP included a new receiver-processor system, a new communications jammer, a new band 2/3 transmitter, an upgrade to the universal exciter function of the radar jamming system, avionics upgrades, airframe and engine improvements. EA-6B improvements that are currently in development, test, or production are:

a) Block-89A. Block 89A is a common configuration baseline for the EA-6B fleet. It includes structural, safety of flight, computer, navigation system, and communications upgrades. This upgrade reached IOC in 4QFY00 and seven of ninety-nine aircraft are complete as of the beginning of FY00. Block-89A configuration is a pre-requisite for the Improved Capability-III (ICAP-III) upgrade discussed below.

b) Various warfighting enhancements. Improvements to the AN/ALQ-99 jamming pod capability include Universal Exciter Upgrade (FRP 4QFY96), Band 9/10 transmitter (IOC 1QFY00), a prototype Band 7/8 jamming capability (derived from the in-production Band 9/10 transmitter), and the EMD development phase Low Band Transmitter (LBT) upgrades. The USQ-113 (Version 3) Connectivity Upgrade (awaiting OT&E) improves the capability to jam enemy communications. Addition of the Multi-Mission Advanced Tactical Terminal and the Improved Data Modem capability improves battlefield situational awareness for the crew. The program is also integrating Aircrew Night Vision Devices (NVD) to enhance night capabilities.

c) ICAP III. ICAP III develops and procures a new tactical receiver that provides a reactive jamming capability and replaces the current 1960s era receivers. Additionally, ICAP III systems integrates many of the above mentioned warfighting enhancements with the addition of new controls and displays, allowing improved crew operation. ICAP-III includes provisions for Link-16, via the Multi-Functional Information Distribution System. ICAP-III builds upon the Block-89A improvements to achieve integrated receiver connectivity and reactive jamming/targeting capability through accurate geolocation of active emitters. The procurement plan is to transition all EA-6B aircraft to the ICAP-III configuration by 2010. Of the EA-6B upgrade programs, the ICAP-III program is the only ACAT II program.

TEST & EVALUATION ACTIVITY

Block 89-A. Suitability deficiencies (incomplete NATOPS manual documentation) identified in this upgrade program's OPEVAL were resolved and the system reached IOC in 4QFY00.

USQ-113 Version 3. DT was completed in April 2000. However, as a result of an Operational Test Readiness Review (OTRR) in May of 2000, OPEVAL is was held until the program office addressed certain safety of flight issues involving the use of a laptop computer in the rear cockpit as an interface to the communications receiver/jammer capabilities. In October 2000, a second OTRR resulted in a successful certification for OPEVAL to begin. USQ-113 was already declared EOC in May 1999 and deployed to two fleet EA-6B squadrons in support of air operations over Serbia.

Low Band Transmitter (LBT). The Navy re-baselined the LBT upgrade to the AN/ALQ-99 jammer in September 2000, slipping the program IOC from 3QFY04-2QFY05. The resultant TEMP revision is in progress. During the program restructure, the PEO directed anechoic chamber tests of the transmitter/antennas. These tests took place in August 2000 with favorable results: no catastrophic failures and an assessment by the program office that the problems encountered can be resolved within program cost and schedule constraints. EMD and DT&E activities continue to progress.

NVD. NVD integration DT was conducted in August and a Quick Reaction Assessment (QRA) was conducted in September 2000. No major deficiencies were noted prior to the QRA other than insufficient NATOPS documentation. The QRA found the upgrade effective, and recommended that operational testing be done to substantiate the opinions in the QRA.

ICAP-III. The Navy re-baselined the ICAP-III upgrade in May 2000 as a result of cost growth due to underestimating the complexity of the LR-700 receiver design, software, and development requirements. IOC slipped from 3QFY04 to 2QFY05. A TEMP revision is in progress. A significant feature of the restructure is that the new acquisition strategy eliminated an LRIP decision, and the concomitant operational test, originally planned in FY02. The key feature of ICAP-III, the LR-700 receiver, prepares for integration into test aircraft and the beginning of DT in FY01.

TEST & EVALUATION ASSESSMENT

DOT&E oversight focuses on ICAP-III, LBT, and USQ-113 Version 3 upgrades; Block-89A and NVD upgrades are essentially complete. USQ-113 Version 3 will eventually complete OPEVAL and provide an improved, safer capability for communications jamming. Recent technical progress and successful anechoic chamber tests have buoyed the LBT upgrade, which now has an executable schedule.

Of the EA-6B upgrades, the ICAP-III program has both the most risk and the promise of greatest reward. Program risk is centered on development of the LR-700 receiver; without it, ICAP-III does not offer much in overall combat capability enhancements beyond new displays. However, if the program office is successful in shepherding an adequate receiver design and software development profile, ICAP-III can provide a much needed reactive jamming and accurate emitter geolocation capability in full azimuth coverage. In restructuring the program, however, an OA and LRIP assessment were eliminated, which inherently increases program risk. To compensate, the program office should imbed an OA early enough in TECHEVAL (DT) so that OT events take place early enough for the OTA to prepare for OPEVAL and for the program to correct deficiencies prior to the subsequent Operational Test Readiness Review. Since ICAP-III integrates new and old avionics supporting all mission roles of the weapons system, the final OPEVAL should be a robust, comprehensive, and challenging flight test of the improved EA-6B's ability to jam and launch HARMs in a composite force, multi-ship environment.

EVOLVED SEA SPARROW MISSILE (ESSM)

Navy ACAT II Program

Total Number of Systems:	2,076 (U.S. only)
Total Program Cost ((TY$):	$1,615.2M
Average Unit Cost (TY$):	$0.656M
Full-rate production:	FY03

Prime Contractor

Raytheon Systems Company,
Tucson, AZ

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Evolved Sea Sparrow Missile (ESSM) is a short-range missile intended to provide self-protection for surface ships. On Aegis ships, ESSM will be launched from the MK 41 Vertical Launch System, requiring a thrust vector control system on the ESSM rocket motor; guidance will be by up-linked commands until the ESSM is near the target, at which time guidance will transition to semi-active homing on reflected radar signals from the target. It may also be launched in a home-all-the-way mode (no up-linked commands). On non-Aegis ships (aircraft carriers, amphibious assault ships, other surface combatants), it will be fired from other launch systems; guidance will be in homing all the way to intercept. ESSM uses an 8-inch diameter forebody that includes a modified guidance section from the in-service RIM-7P Sea Sparrow. The guidance section, which includes a radome-protected antenna for semiactive homing, attaches to a new warhead section. A new transition section connects the warhead to the rocket motor and contains a computer, an inertial measurement unit, a warhead-compatible telemeter, and an Aegis-only S-Band transceiver. The forebody is attached to a new 10-inch diameter rocket motor, which provides higher thrust for longer duration than predecessor Sea Sparrow missiles. ESSM uses skid-to-turn steering (tail control), whereas earlier Sea Sparrows were wing-controlled. ESSM will retain capability of the RIM-7P missile, but will also have capability against maneuvering anti-ship missiles. ESSM is a cooperative development effort by ten participating governments.

ESSM contributes to the ***Joint Vision 2020*** concept of ***full-dimensional protection*** by enhancing ship self-protection against air threats that have "leaked" past outer air defenses. Given that some of the ships that will use ESSM are also platforms from which strike operations are executed, ESSM indirectly contributes to the concept of ***precision engagement***.

BACKGROUND INFORMATION

Milestone II was conducted in November 1994. The TEMP was approved by OSD in January 1995, through the first at-sea phase of developmental testing. The results of this testing were supposed to provide the data for an operational assessment supporting the LRIP decision. This provisional approval was assigned because the aerial targets proposed in the TEMP for the DT and OT (in support of the full production decision) were unacceptable in adequately representing Anti-Ship Cruise Missile (ASCM) threats. (Since that time, the PEO (TSC) has taken initiatives to obtain targets that are more threat-representative.) During 1998, the program was restructured with an OA based on missile flights at White Sands Missile Range, NM, to support the initial LRIP decision. A second LRIP decision was added and will be supported by testing with the Self Defense Test Ship (SDTS). The full production decision will be supported by an OPEVAL planned for late FY02 or early FY03 conducted with an Aegis destroyer. Subsequent to program restructuring, the TEMP was revised and approved by OSD T&E Principals on March 30, 2000.

TEST & EVALUATION ACTIVITY

Fiscal Year 2000 activity included initial test flights for the DT at the White Sands Missile Range. The DT consists of firing both control test vehicles (CTVs) and guidance test vehicles (GTVs). CTVs are ESSMs with inert guidance sections programmed to execute maneuver patterns. GTVs are ESSMs with guidance sections for homing on targets. The fourth CTV flight test was conducted in November 1999. The first GTV flight test was conducted as a combined CTV/GTV flight in March 2000. GTV-2 was fired at a sub-sonic target drone in July 2000. GTV-3 was fired at a supersonic target in August 2000. GTV-4 was fired at a maneuvering target drone in November 2000. GTV-5 was fired at a low altitude, close-range, sub-sonic target in December 2000. The GTV results will serve as the basis for an OA to support an LRIP decision. Tests were conducted in accordance with a DOT&E-approved TEMP and OA plan.

Activity also included preparation for the two phases of DT/OT planned for FY01: Aegis S-Band testing at the White Sands Missile Range (February-May) and at-sea testing on the Self Defense Test Ship (planned to start in June). Results of this testing will serve as the basis for a second LRIP decision.

TEST & EVALUATION ASSESSMENT

CTV Results. Primary objectives of the four CTV flights were to demonstrate kinematic capability and aerodynamic control during high G maneuvers, evaluate autopilot stability, and collect data to validate simulations. Autopilot performance was closely monitored during these flights, with design changes implemented as the flight series progressed. A “tactical” autopilot was used in the third flight, but performance was marred by loss of roll stability during an early maneuver, resulting in high roll rates that exceeded the capability of the inertial measurement unit. As a result, the autopilot gains were adversely affected for the remainder of the flight. The initial loss of stability was caused by incorrect entries in the autopilot software. A problem that persisted at least through the first three flights was that the rear reference antenna, located near the rocket motor exhaust, suffered thermal damage to its radome, which could have affected RF properties. The seeker antenna radome came apart during the first CTV flight test and, although a failure cause was believed determined at the time, subsequent radome failures during two GTV flights helped isolate the problem to radomes of a particular make (discussed under GTV phase below). A battery failure occurred during the second flight test. The failure cause was determined and the problem was fixed. The fourth CTV flight, conducted from a vertical launch cell, resulted in the thrust vector controller failing to detach from the rocket motor. Failure cause was determined to be a missing g-switch in the control actuation assembly; processes have been implemented to preclude recurrence. The CTVs were launched from both a MK 29 rail launcher and a MK 41 vertical launcher.

GTV phase: Three GTVs were flight-tested during FY00, and two more have been fired in early FY01. GTV-1 was modified to incorporate test objectives from CTV-4. The missile executed the programmed CTV-4 maneuvers, then locked on and guided to successful intercept with a sub-sonic, “middle of the envelope” target drone augmented to increase its radar cross-section. GTV-2 was launched at a sub-sonic drone, at higher altitude than GTV-1, but without the increased radar cross-section. The ESSM seeker antenna radome came apart during flight, precluding terminal guidance on the target. GTV-3 was launched at a supersonic target. The seeker antenna radome on this ESSM also came apart during flight, just as the ESSM began terminal homing on the target. As of this writing, the cause of the radome failures appears to be thermally-induced stress experienced in the high acceleration environment of ESSM. All three radomes that failed were from the same source (which no longer produces them). Of the radomes that performed successfully, three were from a second source, and one was from the first source. The fact that it did not fail is attributed to the less demanding maneuver profile. GTV-4 was launched from a vertical launcher at a sub-sonic, maneuvering target, with successful intercept at medium range and low altitude. GTV-5 was launched from a vertical launcher at a sub-sonic target, with successful intercept at close-in range and low altitude.

Among the significant limitations accompanying the testing of ship-launched missiles at the White Sands Missile Range, that will qualify conclusions drawn from the results of the testing, is the decidedly non-maritime nature of the high desert environment. The harsh environment encountered when engaging sea-skimming ASCMs cannot be adequately represented because targets cannot be flown low enough and the radar reflectivity characteristics of the sea surface cannot be represented. Safety zones surrounding the launcher preclude flying targets directly toward the launcher, creating a crossing aspect that is not present in a self-defense scenario at sea. Further, the fire control system at White Sands Missile Range differs in many respects from those used on ships firing ESSMs.

Self Defense Test Ship Phase. The DT/OT scheduled for FY01 on the Self Defense Test Ship promises to be very realistic, with the opportunity to learn more about ESSM capability in the actual operational environment. The SDTS combat system represents that on non-Aegis ships using the MK 29 rail launch system.

OPEVAL and FOT&E. Although OPEVAL is considered adequate, with the possible interoperability exception noted below, a new ASCM threat has appeared for which there is no credible surrogate to use as a target. Given the time required to obtain such a surrogate, this is expected to be an issue for examination during FOT&E. Limitations in the Aegis Weapon System Baseline 6.3 computer program and shipboard illuminator radars will preclude testing ESSM's capability against surface targets.

Interoperability with Aegis Weapon System. ESSMs are intended to provide close-in defense of Aegis ships against anti-ship cruise missiles, with Standard Missile providing interceptor capability at longer ranges (both self-defense and defense for other ships). There are circumstances where the Aegis Weapon System could be controlling both ESSMs and SM-2s simultaneously. This is primarily an Aegis Weapon System (Baseline 6.3) issue that requires operational testing, either during the ESSM OPEVAL or during DDG 51 FOT&E.

F/A-18 E/F SUPER HORNET

Navy ACAT IC Program

Total Number of Systems:	12 LRIP-1	
	20 LRIP-2	
	548 Production	
Total Program Cost (TY$):	$47.0B	
Average Unit Cost (TY$):	$49.9M	
Full-rate production:	3QFY00	

Prime Contractor
Boeing

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The FA-18E/F Super Hornet is a multi-mission, day/night strike fighter aircraft designed to add to the capability and tactical flexibility of the Carrier Air Wing via improvements in the FA-18 C/D's range, endurance, and carrier bring-back payload and weapons payload. The FA-18E/F features a larger airframe with more fuel capacity, two additional store stations and increased survivability with additional capacity for capability upgrades and growth. This aircraft will also serve as an airborne tanker, further improving Battle Group flexibility and mobility. The projected firepower from Super Hornets operating from aircraft carriers is a key contributor to the Joint Vision 2020 concepts of dominant maneuver and precision engagement.

BACKGROUND INFORMATION

First flight of the FA-18E/F occurred in November 1996. A total of seven aircraft underwent testing during the EMD Phase which involved an integrated team of contractor and Navy pilots accumulating over 5000 flight hours. In April 1992, the DAB approved a Milestone IV/II for the FA-18E/F program. The Navy entered the EMD phase, which concluded in FY00.

A single DAB-level decision was reached in March 1997, with a decision to enter LRIP and delegation to the Navy of the Milestone III full-rate production decision.

OT-IIA was completed in November 1997, with an assessment of potentially operationally effective and potentially operationally suitable. Flight testing focused on validation of the performance data base to assess the accuracy of range and performance predictions. All evaluated key performance parameters were met.

OT-IIB, conducted in two phases, was completed in November 1998 with an assessment of potentially operational effective and potentially operationally suitable. An expanded envelope afforded the pilots the opportunity to evaluate the aircraft in a wide variety of tactical roles such as Weapons Delivery Accuracy, Dissimilar Air Combat Maneuvering, Night Vision Device Suitability, Fighter Escort, Interdiction, and Close Air Support.

OPEVAL was conducted from May to November 1999. Seven production aircraft were tested in a variety of rigorous and operationally realistic environments. Much of the testing took place at China Lake, CA with three deployments to other locations, including aircraft carrier operations.

Prior to full-rate production, three LRIP lots were planned and acquired. LRIP-1 (12 aircraft), LRIP-2 (20 aircraft) and LRIP-3 (30 aircraft) are currently under contract. LRIP-1 includes the seven aircraft that were utilized during OPEVAL.

The FA-18E/F Live Fire Test and Evaluation Program was granted a waiver to conduct less than full-up, system-level testing in May 1992. With the waiver approval, the program was required to execute an Alternative Plan, which included comprehensive ballistic testing of components and major assemblies. Building on the vulnerability reduction program for the early FA-18 aircraft and joint live fire testing of the FA-18C, as well as actual combat damage incidents, the Navy executed an aggressive LFT&E program for the FA-18E/F. Testing was completed on full-up drop test aircraft reconfigured for Live Fire testing. These tests include precedent setting ballistic shots with a running F-414 engine.

Although the FA-18E/F is approximately 20 percent larger than the FA-18C/D, its vulnerable area has not increased proportionally. One of the major survivability improvements was a redesign of the wall between the fuel tank and the engine inlet duct to mitigate a fire potential. Another major improvement is the addition of active fire suppression systems in the fuselage dry bays adjacent to fuel tanks that have proved effective during Live Fire testing. LFT&E and IOT&E results were reported to Congress on March 30, 2000 and supported the FA-18E/F approval of full rate production in April 2000.

Although OPEVAL found FA-18E/F to be operationally effective and operationally suitable in all mission areas, several OT issues relating to missing or deficient systems were identified as needing further attention by DOT&E. Among these were:

1. Large number of external stores carriage/release limitations that required additional testing to resolve.

2. Noise and Vibration levels in the under-wing environment and their effect on weapons/stores.
3. Integration/replacement of key systems.

TEST & EVALUATION ASSESSMENT AND RECOMMENDATIONS

OPEVAL summary

OPEVAL was conducted using three FA-18E (single-seat) aircraft and four FA-18F (two-seat) aircraft delivered under Low Rate Initial Production (LRIP). Although not all planned weapons for the FA-18E/F were cleared for use during OPEVAL, 29 distinct load-out configurations were employed for the test. The aircraft and the payloads tested in OPEVAL were representative of the operational configurations to be fielded.

The IOT&E Air-to-Ground Phase evaluated Air-to-Ground Weapons, Air-to-Ground Sensors, Air Combat Maneuvering, Defense Suppression, Tactics and Survivability. There were multiple ordnance flights dropping a variety of weapons such as Mk 82 (500 lb.), Mk 83 (1,000 lb.), and CBUs (cluster bombs). Also, for the first time since the A-6 aircraft, a new organic "by design" tanking capability was demonstrated by the FA-18E/F during day and night operations.

The Air Combat Phase took place at NAS Key West, FL, and assessed portions of Fighter Escort, Combat Air Patrol, Air Combat Maneuvering, Tactics, and Survivability issues. Scenarios included up to four Super Hornets versus an equal or larger number of F-16C opponents emulating the latest generation MiG-29 threat aircraft flying realistic threat tactics. Mixed formations of FA-18Cs and Super Hornets were also tested and compared.

The Super Hornet conducted Carrier Operations from the deck of USS JOHN C. STENNIS (CVN 74) and was integrated into Carrier Air Wing NINE conducting simulated alert launches, long-range strikes and aerial refueling.

The FA-18E/F operated from Nellis AFB, NV, participating in a Combined/Joint Exercise Red Flag, an intense training exercise involving Air Force, Navy, Marine Corps and multi-national assets. A realistic air campaign was conducted to attack representative threat targets with inert and live munitions. Adversary aircraft and multiple surface-to-air threat systems opposed these assets.

Operational testing at China Lake focused upon survivability flights and the delivery of air-to-air missiles and smart weapons. Survivability flights involved the conduct of operationally representative strike missions, using targets defended by a variety of actual and surrogate threat surface-to-air missile systems along their en route flight paths. Air-to-air gunnery and air-to-ground sensor flights were also completed at the China Lake operational testing facilities.

The following operational test limitations were encountered and managed:

- The FA-18E/F Acquisition Logistic Support Plan calls for 12.5 maintenance personnel per aircraft for the FA-18E and 11.9 maintenance personnel per aircraft for the FA-18F. For the seven aircraft participating in OPEVAL, this would allocate 85 maintenance personnel. During OPEVAL, however, the Navy maintenance team was comprised of only 54 persons. As a result, the aircraft availability threshold was not met during OPEVAL. To resolve this

COI, a correction factor was devised and applied by DOT&E based on a reasonable expectation of maintenance man-hours that would have been available with the full complement of 85 personnel. With the application of this correction factor all suitability COI's were successfully resolved.

- Not all stores combinations intended for eventual utilization by the FA-18E/F were cleared for carriage and release during OPEVAL. While the configurations available were extensive for this phase of testing, there were numerous restrictions involving weapon type, weapon quantity, release interval, multiple release and mixed loads that were not available during OPEVAL.
- Due to an increased noise and vibration environment discovered under the wing of the FA-18E/F during developmental testing, a variety of hardware security problems were encountered with various stores. As a result, additional and more frequent inspections of air-to-air missiles were required during OPEVAL.
- Live Fire Testing was adequate with minor limitations:
- The live fire tests of the engine bay fire extinguishing system were not sufficiently realistic to verify the effectiveness of that system.
- Although the tests verified that the fuel tank ullage (fuel-air mixture) would be in the explosive range under certain known conditions, operational data is lacking to determine how often these conditions will occur during typical mission scenarios.
- Although testing on the FA-18E version (single-seat) was adequate to determine the potential for crew casualties from an adjacent fuel tank ullage explosion, the results do not necessarily extrapolate to the FA-18F configuration (two-seat) because the rear seat of the FA-18F is closer to the ullage area than the single-seat in the tested configuration.
- The vulnerability estimates produced by the state of the art vulnerability models used in this program were incomplete in their predictions of target damage. Many sources of aircraft damage (e.g., fires, toxic fumes, blast, bending, ricochet, projectile breakup, spall, secondary spall, and delamination) are not modeled well or not modeled at all.

Follow-On Test and Evaluation (FOT&E)

The Navy Roadmap for the Super Hornet calls for the incorporation of many subsystems that are expected to increase that aircraft's effectiveness and survivability. Of primary importance are the Active Electronically Scanned Antenna (AESA), the Advanced Targeting Forward Looking Infrared Radar (ATFLIR), and the Joint Helmet Mounted Cueing System (JHMCS), discussed in this report under *Hornet Upgrades*.

Periods of FOT&E are planned to evaluate the enhancements to the Super Hornet that these new subsystems are postulated to provide. The first of these FOT&E periods, OT-IIIA, is scheduled for Sep01 to Feb02 and will support 1st deployment with Operational Tests on Joint Standoff Weapon (JSOW), Joint Direct Attack Munition (JDAM), Integrated Defensive Electronic Counter Measures (IDECM) Block 2/3 (OPEVAL), Tactical Aircraft Moving Map Capability (TAMMAC), Positive Identification/Conformal Antenna System (PIDS/CAS)(OPEVAL), Multifunction Information Distribution System (MIDS) (OA), Joint Helmet Mounted Cueing System (JHMCS) (OPEVAL) and Shared Aerial Reconnaissance Pod(SHARP) (OA). The second FOT&E period will be Nov02 to Feb03 with Lot 24 configuration aircraft and will test GBU-24B/B, MIDS and DCS to support the second deployment for the FA-18E/F. DOT&E will closely monitor the FOT&E periods and will include our assessment in future annual reports.

Since the completion of OPEVAL, the Developmental Test community has been exploring the Noise and Vibration issues through a flight test program intended to assess the efficacy of various airflow "trim" fixes devised to smooth out turbulence-induced vibrations. These fixes include various fairings, trim strips, vortex generators and fences. A series of 17 dedicated flights have been defined and scheduled for the October through December 2000 timeframe. DOT&E will closely monitor progress in this activity.

The Operational Test community has been actively pursuing the ordnance carry/release restrictions in order to clear as many as possible by the time of the first deployment. Little progress has been made in this regard, however, due to competing priorities and asset availability. DOT&E remains focused on continuing DT/OT efforts to correct deficiencies identified in the FA-18E/F OPEVAL.

F/A-18 E/F UPGRADES

ACTIVE ELECTRONICALLY SCANNED ARRAY - AESA

<u>Navy ACAT IC Program</u>		**<u>Prime Contractor</u>**
Total Number of Systems:	258 (192 potential retrofit)	Raytheon
Total Program Cost (TY$):	$385M RDT&E	
	$1.13B (APN-1)	

ADVANCED TARGETING FORWARD LOOKING INFRARED - ATFLIR

<u>Navy ACAT IC Program</u>		**<u>Prime Contractor</u>**
Total Number of Systems:	547	Boeing
Total Program Cost (TY$):	$1.1B	Raytheon (Major Subcontractor)
Average Unit Cost (TY$):	$1.9M	

<u>SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020</u>

The FA-18E/F F Super Hornet, is an advanced derivative of the FA-18 C/D now in operational service with the Navy, Marine Corps, and several foreign countries. Designed to overcome existing deficiencies in FA-18 C/D range, endurance and carrier bring-back payload and weapons payload capability/flexibility, the new design features a larger airframe with more fuel capacity and two additional store stations. It also has a reduced radar signature, increased survivability engines, extensive use of composites, and improvements to some avionics and displays. The projected firepower from Super Hornets operating from aircraft carriers is a key contributor to the ***Joint Vision 2020*** concepts of ***dominant maneuver*** and ***precision engagement***.

Individual Upgrade Descriptions

Active Electronically Scanned Array (AESA)

AESA represents the last of three preplanned upgrades to the FA-18 radar and is being developed to dramatically increase FA-18E/F warfighting capability. It should provide significant lethality and survivability enhancements, greatly improved detection, EP performance, and enhanced signature characteristics for the aircraft. It will correct current APG-73 hardware and software deficiencies, lack of growth capability and allow near-simultaneous operations of different modes of the radar while increasing overall reliability and flexibility. AESA will enable new workload strategies within the cockpit in the FA-18F, substantially increasing multi-mission effectiveness by allowing each crewman to independently perform different mission functions near simultaneously.

Government and Industry have been working since 1992 on AESA requirements and technical definition. DARPA, JSF, ONR, and USAF programs significantly reduced technical and affordability risks for this type of system. Provisions for growth to support AESA are already embedded in the FA-18E/F. Boeing has total system performance responsibility for integrating the AESA radar system into the aircraft and competitively selected Raytheon as the AESA supplier. The process fully utilizes Boeing Integration expertise and supports Acquisition Reform initiatives.

- Jul 98: Decision to formally compete radar subcontract through Boeing.
- Dec 98: PBD 752 adds $660M in FY00-05 to partially fund AESA program.
- Apr 99: AESA fully funded in FYDP with PBD752 and PR01 submit.
- Jul 99: USD (A&T), OSD(C) Decision to Proceed with New Start Notification to Congress.
- Jan 01: Expected Milestone II decision

Because of the importance of AESA as a roadmap system for the FA-18E/F aircraft, DOT&E has placed it on oversight. AESA is a multi-phase program. In Phase I (Pre-E&MD Activities and Prototype Development) Boeing conducted a competitive source selection for radar system subcontract under advanced agreement. Agreement for prototype development (FY99-FY01) included commercial development and amortization provisions. In Phase II, EMD program/contract will support a Milestone II decision in FY01. Phase III: E&MD (January 2001-July 2006). Phase IV comprises LRIPs I, II, & III comprising 42 units (FY03-08, FY04-12, FY05-22). Phase V is Full-rate production (FY06). The program is currently fully funded and on track.

Advanced Targeting Forward Looking Infrared (ATFLIR)

ATFLIR represents a the latest, third generation of technology in infrared targeting capabilities, including navigation FLIR, laser spot tracker, air-to-air laser ranging, electronic zoom, geographic-point targeting, and Electro-optics.

The existing AN/AAS-38B FLIR pod currently deployed in FA-18C/D squadrons has known deficiencies in magnification and resolution resulting in insufficient performance for target location and precise aimpoint selection outside threat envelopes, particularly from higher altitudes. ATFLIR will incorporate sensor technologies intended to maximize air-to-ground targeting performance. Testing began in FY99 and will IOC in FY03. This next generation technology will operate at shorter wavelengths than previous systems, have 3 nominal fields of view to include a very narrow 0.7 degrees, incorporate a larger detector array and allow operations up to 50,000 feet pressure altitude.

First flight of the EMD pod and start of the DT-IIB Test Phase occurred in November 1999. OT-IIA was June/July 2000, and involved 20 C/D flights. OT-IIA revealed five major anomalies requiring corrective action:

1. ATFLIR overheat on deck, requiring the pilot to wait until airborne to turn the pod on and initiate Built in Test that should be done prior to flight to ensure reliability.
2. Stuck Field of View (FOV) when attempting actuation commands.
3. Uncommanded pod shutdowns during high "G" initiated flight conditions.
4. Multiple break-locks during auto-track deliveries.
5. Laser failures airborne requiring power recycling to reset the pod.

In September 00 the program objectives were re-addressed. To move the program from a high-risk program in schedule, cost and performance, to medium risk status required a schedule re-alignment and design modification of the Electro-Optical Sensor Unit (EOSU). Early involvement in the developmental/operational testing of ATFLIR has properly identified areas of concern in meeting Key Performance Parameters and ensuring second FA-18E/F deployment availability.

Most anomalies identified in OTIIA have been mitigated or largely reduced through mission computer software changes and interface improvements. Uncommanded Pod shut downs are not fully understood at this time. Recognition range performance KPP compliance will determine program progress. Upgraded EOSU underwent Developmental Testing during Oct/Nov00 timeframe with an LRIP-I Decision expected in Dec00.

OT-IIB (OPEVAL) is currently scheduled for 1Q03.

TEST & EVALUATION ASSESSMENT

AESA is on track to increase performance and capabilities to the Super Hornet. DT activity to date includes laboratory bench testing of prototype array modules and an assessment of the anticipated array performance using modeling and simulation of a completed array using the bench-testing results. Simulation results indicate the potentially attainable performance of AESA will meet or exceed requirements. There is reason to have high confidence in the simulated results since the contractor has previously demonstrated the accuracy of this simulation in a similar antenna program. DOT&E will continue to monitor this effort until hardware becomes available for OT assessment. Early OT involvement is essential to ensure full integration with contributing new systems such as the Advanced Mission Computer & Displays, Fiber Channel Network Switch, Software Configuration Set High Order Languages, Advanced Crew Station and the advances in the aircraft avionics cooling system are compatible.

ATFLIR is presently high risk in performance, schedule and cost, requiring a restructuring of this program. Design tests underway at China Lake will determine if target recognition range Key

Performance Parameters are attainable. Restructuring of the Test and Evaluation Master Plan has slid the program one year to the right. Many uncertainties remain in this challenged program.

The effectiveness and survivability of the FA-18E/F depends heavily on the health of these programs. Although they are separate systems with individual TEMPs, their integration is paramount to insure carrier aviation remains relevant and the Vision 2020 precept of ***precision engagement*** is met.

FIRESCOUT VERTICAL TAKEOFF AND LANDING TACTICAL UNMANNED AERIAL VEHICLE (VTUAV) SYSTEM

Navy ACAT II Program		**Prime Contractors**
Total Number of Systems:	23 (12 USN, 11 USMC)	Northrop Grumman-Ryan
Total Program Cost (TY$):	331.6M	Aeronautical Center

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Vertical Takeoff and Landing Tactical Unmanned Aerial Vehicle (VTUAV) system is to provide Reconnaissance, Surveillance, and Target Acquisition (RSTA) and communications relay capability in support of littoral operations for the Navy and Marine Corps. The purpose of the VTUAV system is to collect and pass information utilizing an airborne sensor platform that will provide the commander with an extended and enhanced battlespace situational awareness. VTUAV will incorporate an Electro-Optic (EO/Infrared (IR)/Laser designator payload, and is to deliver timely, accurate, and complete information about the Commander's area of interest in near real-time. VTUAV will provide the tactical commander with ***information superiority,*** contributing to the ***full-dimensional protection*** of his force and ***precision engagement*** of the enemy.

A VTUAV system consists of three air vehicles with payloads, a ground control element (ship-based for the Navy and HMMWV-based for the Marine Corps), data link equipment, a remote data terminal, and associated ground support equipment. The FireScout air vehicle is based on the Schweizer Aircraft Corporation Model 330 manned turbine helicopter. The most significant change from the manned version is the replacement of the cockpit with a redundant flight control system including actuators, avionics, and software to support unmanned flight and payload operations. The FireScout has a gross takeoff weight of 2,550 pounds, cruises at 110 knots, and can loiter on-station at 110 nautical miles for over three hours. An existing Allison Rolls Royce gas turbine engine powers the air vehicle. The ground control element will use the Tactical Control System architecture to support system functionality and intelligence dissemination to other C^4I nodes.

The operational tempo calls for one VTUAV system to provide 12 continuous hours on station at 110 nautical miles. This will be accomplished with more than one air vehicle and conducting relief on station operations. The command and control architecture using the tactical command data link and ARC 210 UHF/VHF radio allows one ground station to monitor up to three air vehicles simultaneously while receiving imagery from one of the airborne platforms.

BACKGROUND INFORMATION

Between 1998 and 1999, the Navy conducted extensive technical demonstrations with vertical takeoff and landing (VTOL) unmanned aerial vehicles, including shipboard demonstrations last winter. Three contractors participated in these demonstrations: Bell Helicopter, SAIC, and Bombardier. As a result of these demonstrations, the Navy decided that a VTOL capability was technically feasible to meet their mission needs. Therefore, when in November 1998, the JROC directed the Navy and the Army to pursue separate air vehicle solutions to satisfy their tactical UAV requirements, the Navy submitted their operational requirement for a vertical takeoff and landing tactical UAV. The JROC subsequently validated the Navy's VTUAV ORD in January 1999, with the following Key Performance Parameters (KPPs): ability to conduct VTOL operations from a land-based site and all air capable ships; ability to maintain a steady state hover; automatic launch and recovery capability; 200 pound payload capability; deck restraining capability; ability to transfer control of the air vehicle from one ground control station to another; and ability to use either JP-5 or JP-8 heavy fuel. Although the ORD did not specifically identify a KPP for interoperability, the test and evaluation plan will examine the interoperability capabilities of the VTUAV system.

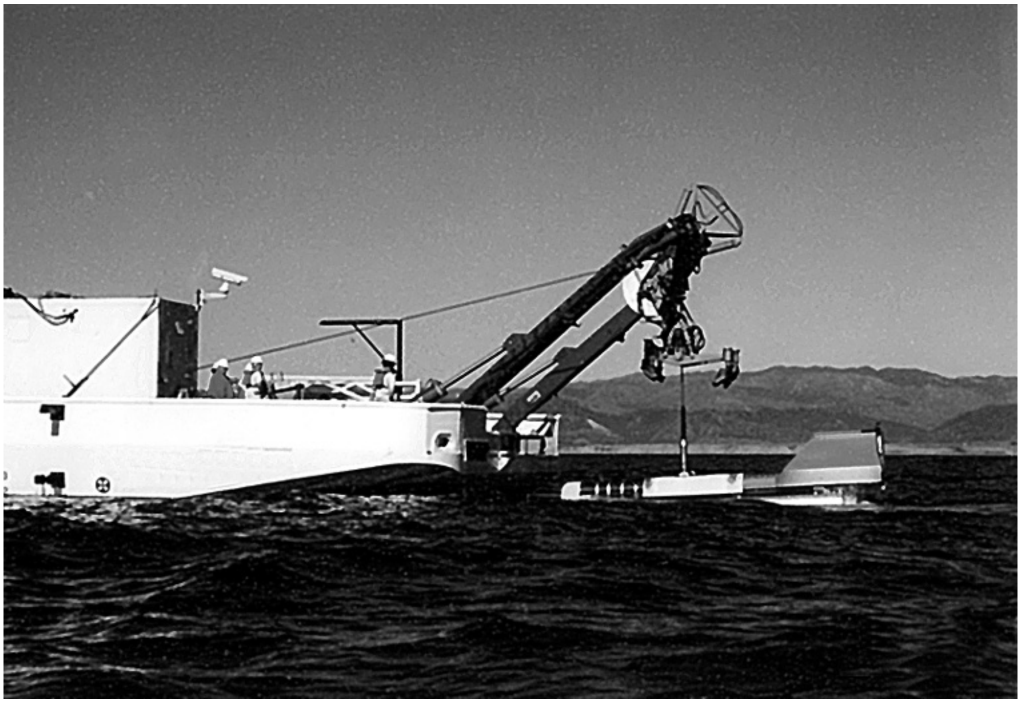
On August 31, 1999, the Assistant Secretary of the Navy for Research, Development, and Acquisition (ASN(RDA)) approved the VTUAV acquisition strategy. The program office subsequently released their official request for proposals. ASN(RDA) approved Milestone II on January 21, 2000, and the VTUAV contract was awarded on February 9, 2000 to Northrop Grumman (Ryan Aeronautical Center) for the EMD of the FireScout VTUAV systems. Note that of the three contractors participating in the technology demonstrations, only one, Bell, competed for the VTUAV contract against Sikorsky and Northrop Grumman.

TEST & EVALUATION ACTIVITY

No operational testing was conducted this year on the VTUAV. This office approved the TEMP in August 2000. One year of EMD is to be followed by an LRIP contract for two systems in March 2001. The LRIP decision will be supported by information obtained during design reviews and limited developmental testing with prototype air vehicles and ground components. Initial operational testing is scheduled for July 2002. IOT&E will be conducted with the first LRIP system, a Marine Corps land-based VTUAV System with one L-class ship control station.

Prior to the contract award, 39 manned flights of the Model 379 (for a total of 41 flight hours) were accomplished. In January 2000, the first unmanned fully autonomous flight took place at NAWC China Lake. The same prototype air vehicle (P1) successfully completed additional flight testing in June 2000. Several anomalies were detected related to flight computer capacity, engine starts, engine RPM, tachometer, and radar altimeter. The contractor developed solutions to the anomalies and flight testing resumed in November 2000. After a successful autonomous flight, the air vehicle crashed into the ground and was totally destroyed. An accident investigation is underway. Flight testing with a manned platform will continue until another unmanned prototype is available in late 2001.

FIXED DISTRIBUTED SYSTEM (FDS) AND ADVANCED DEPLOYABLE SYSTEM (ADS)



Navy ACAT II Programs		**Prime Contractor**
Total Number of Systems:	1 FDS, 9 ADS	Raytheon and Lockheed Martin
Total Program Cost (TY$):	FDS-$1095.7M ADS-$1370.7M	
Average Unit Cost (TY$):	FDS-$1095.7M ADS-$46.1M	
Full-rate production:	ADS-FY05	

SYSTEM DESCRIPTIONS & CONTRIBUTIONS TO JOINT VISION 2020

The Fixed Distributed System (FDS) is an ocean surveillance system that employs seabed acoustic sensors distributed over large ocean areas to detect, classify, localize, and track submarine contacts in selected areas of the world. The Advanced Deployable System (ADS) is a littoral water deployable undersea surveillance system designed to provide the Joint Force Commander with a timely and reliable picture of undersea activity. Both of these systems contribute to ***Joint Vision 2020 full-dimensional protection*** through ***information superiority***. FDS consists of two sub-systems: an Underwater Segment (UWS) and a Shore Signal Information Processing Segment. FDS was designed to augment the existing Sound Ocean Surveillance System and be compatible with the Integrated Undersea Surveillance System, including Surveillance Towed Array Sensor System ships. Similarly, ADS consists of an Under Water Segment, a Processing and Analysis Segment, and a Mission Support Segment.

BACKGROUND INFORMATION

Engineering development of FDS commenced in 1989. An initial seabed sub-system for the first FDS was installed and became the test article for OT. Initial operation of this system occurred in 1995. Plans had called for procurement of 11 operational systems through 2006. However, the Navy truncated the program and limited procurement to the engineering development model for the first full field, an additional FDS system, and training equipment. The additional system supported the demonstration of a rapidly deployable variant, FDS-D (deployable) in 1994. The FDS-D experiment proved the deployment and retrieval concepts and successfully demonstrated the FDS acoustic detection and tracking concepts with submarine targets using Navy operators. The FDS-D experiment led to the signing of the ADS ORD in 1994. The TEMP was drafted and development proceeded.

After the entire system FDS-1 was installed and operating and the initial Surveillance Direction System software (SDS) was installed, an OA of FDS (OT-IID / SDS OT-I) was conducted at the FDS-1 site in September 1996. SDS is the command and control component that interfaces the FDS with the Integrated Undersea Surveillance System. This OA was conducted in lieu of an OPEVAL due to the cancellation of FDS Milestone III in 1994.

COMOPTEVFOR found FDS potentially operationally effective and potentially operationally suitable but noted some problems in the areas of tactical support and survivability. FDS achieved Full Operational Capability in September 1996. Due to the cancellation of OPEVAL and Milestone III, testing in accordance with the FDS TEMP 1009 Rev. 2.3 has been essentially completed.

Initial system-level testing of ADS was conducted in March 1998 in an Integrated Article Test designated OT-IA. The test configuration consisted of two complete nodes of the system deployed in shallow water. The objectives included exercising the emplacement procedures and calibrating the in water segment as to location, orientation, and straightness. The arrays were deployed by a craft of opportunity. The Processing and Analysis Segment was installed in shore-based vans. The full system was exercised using the current software build and included classification and target tracking of real targets and a towed projector.

Using the Integrated Article Test results, modeling and simulation reviews, and other development tests dating back to 1996, COMOPTEVFOR completed an Early Operational Assessment of ADS in June 1998. The COOP variant of ADS was assessed to be potentially operationally effective. Potential operational suitability could not be determined due to system immaturity. Four significant areas of risk were identified by this Early Operational Assessment: Deployment Time, Joint Interoperability, Interoperability, and Tactics.

An Operational Assessment (OT-IB) was conducted on the ADS system over a 60-day Fleet Exercise Test (FET), in conjunction with various U.S. Third Fleet sponsored exercises between March-May 1999. In support of this OA, an installation of ADS was deployed offshore in a fleet operating area. ADS was tested using a DOT&E approved test plan as a combined DT/OT that included a one week Limited Objective Exercise (LOE-99) conducted as a phase of Fleet Battle Experiment ECHO, a one week Amphibious Readiness Group Exercise (Kernel Blitz-Prime), and a one week Carrier Battle Group Exercise. These exercises provided scenarios to examine the value of ADS deployed in shallow waters to support joint operations in littoral areas. DOT&E observed this test, which included four submarines, (one SSBN, two SSNs and one diesel electric) and multiple surface vessels as targets for ADS. Navy personnel were trained and used as operators. The background noise conditions imposed by coastal traffic and fleet naval vessels were severe during this test but representative of the expected operational environment. The Craft of Opportunity variant of ADS was assessed to be potentially operationally effective and potentially operationally suitable. Three significant areas of risk were identified by this OA: underwater segment survivability, interoperability, and training.

TEST & EVALUATION ACTIVITY

The ADS ORD was signed in December 1999. An ORD clarification letter outlining plans for incremental development of ADS was provided by the program sponsor, Director, Submarine Warfare, in July 2000. These documents reflect important changes in ADS, including additional configurations and deployment methods. Throughout the year DOT&E participated in a series of TEMP and concept of operations working groups and program reviews. The first draft of a revised TEMP is nearing completion.

In September 2000 DOT&E observed OT-1C, an operational test of one of the deployment options for the ADS. Specific information on the purpose and objectives of OT-1C is contained in the classified annex to this report. ADS OPEVAL is planned for FY04.

TEST & EVALUATION ASSESSMENT

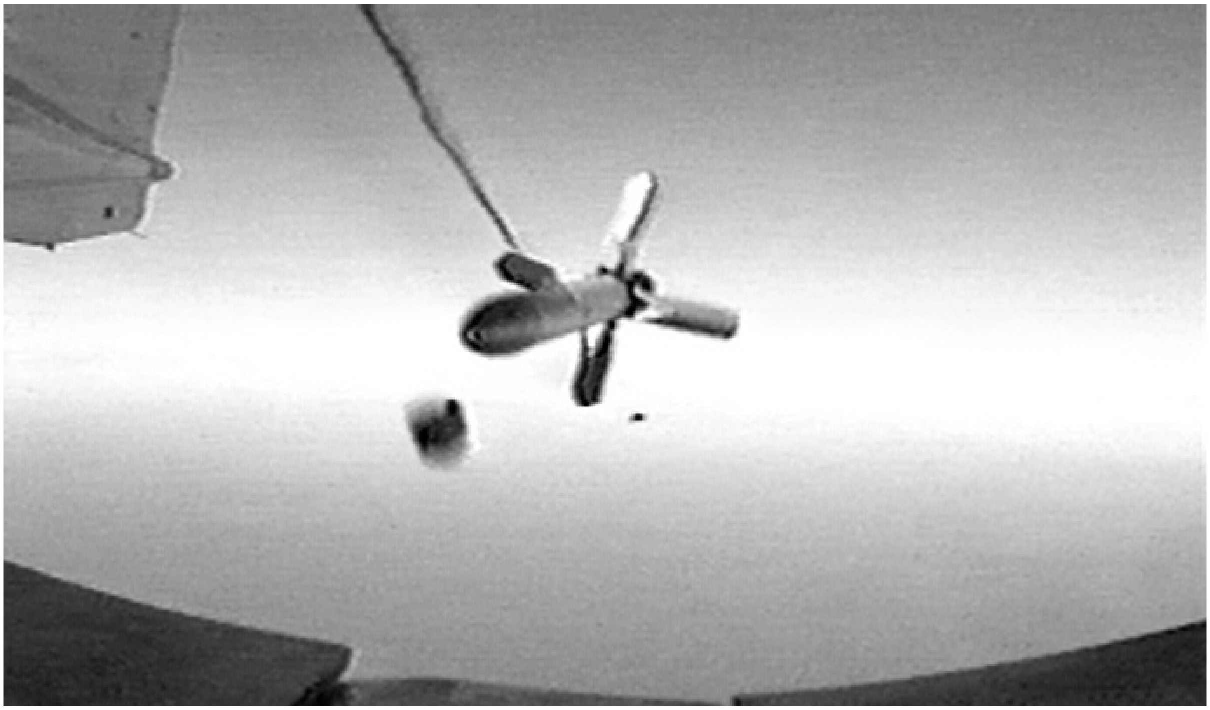
COMOPTEVFOR completed the final report for OT-IB in December 1999. Performance of the ADS system during the LOE-99 was disappointing. ADS did not generate enough target information that was recognized by the operators and the C^4I systems provided to report the information did not perform as required. Subsequent analyses of the recorded acoustic data has shown that, in many cases, target information was present and detectable on ADS despite the high background noise levels, even though not detected/recognized by the operators. This was primarily due to insufficient operator training with actual ADS equipment. As a result, the ASW commander did not receive the target queuing information needed to protect the fleet units from submarines in LOE-99. However, the performance of the operators improved markedly for the subsequent Kernel Blitz-Prime and carrier battle group exercises, largely due to the learning experience provided by the earlier test.

DOT&E approved the OT-1C test plan. While the deployment method was physically demonstrated, several technical problems impacted the schedule and ability to assess detection capability. COMOPTEVFOR is analyzing data collected from this DT/OT event and will submit an operational assessment in January 2001.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

The ADS program has some difficult technical challenges to overcome in 2001. The performance requirements of the new ORD are more demanding and are being incorporated in the revised TEMP. The program must correct the deficiencies revealed in OT-1B in the areas of C^4I and the concept of operations and any additional deficiencies that may come out of OT-1C. The primary risk area in the ADS program is, however, cable survivability and its impact upon attaining the operational availability threshold specified in the ORD. New cable survivability information learned during FET and other testing requires the ADS program office to develop additional measures to mitigate this risk.

INTEGRATED DEFENSIVE ELECTRONIC COUNTERMEASURES (IDECM) AN/ALQ-214



Navy ACAT II Program

Total Number of Systems:	459
Total Program Cost (TY$):	$2.71B
Average Unit Cost (TY$)	
F/A-18 E/F:	$2.27M
B-1B:	$2.03M
F-15 (SCA only):	$0.10M
Full-rate production:	3QFY02

Prime Contractor

Sanders (Lockheed Martin)

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Integrated Defensive Electronic Countermeasures (IDECM) program contributes to the ***Joint Vision 2020*** concept of ***full-dimensional protection*** by improving individual aircraft probability of survival.

The IDECM suite is intended to provide self-protection and increased survivability for tactical aircraft against radio frequency (RF) and Infrared (IR) surface-to-air and air-to-air threats. The major hardware component to be developed by the IDECM program is the IDECM radio frequency countermeasures (RFCM) system and the ALE-55 Fiber Optics Towed Decoy (FOTD), which can be trailed at varying lengths behind the aircraft to optimize RFCM techniques against threat missiles and tracking/targeting systems.

The RFCM consists of an on-board receiver/processor/techniques generator that stimulates FOTD or on-board transmitters for transmission of the countermeasure technique. Tailored RFCM techniques are generated onboard the aircraft and sent to the FOTD via a fiber optic cable or to on-board transmitters. FOTD is intended to be compatible with and deployed from the ALE-50 launch controller used with the advanced airborne expendable decoy (AAED).

IDECM will integrate specific electronic self-protection systems on the host aircraft. In addition to RFCM and FOTD for the IDECM lead aircraft (F/A-18E/F), these systems are defined as the radar warning receiver, the Common Missile Warning System, the AN/ALE-47 chaff/flare dispenser, and an off-board decoy launch controller/dispenser. In 2QFY99, the Navy decided to add an on board jamming capability to complement FOTD off board capability. Addition of an on board jamming capability will allow a full self-protection capability throughout the entire operational flight envelope of tactical strike aircraft. Even if operational maneuvers or engagements deplete the limited numbers of FOTDs carried, the platform will still have a capable self-protection suite.

Upon completion of its own OPEVAL, the Advanced Strategic Tactical Expendable is one of several expendables that may be dispensed by AN/ALE-47. Integration of the entire IDECM suite (ALR-67, ALE-47, FOTD, and RFCM) is intended to provide integrated threat radar warning, threat missile detection/warning, and optimized countermeasure response to increase survivability of the host aircraft against IR and RF threats

BACKGROUND INFORMATION

IDECM was intended to fill the electronic self-protection operational deficiency for Navy tactical aircraft beginning with the first F-18E/F operational deployments in 2002. USAF requirements for a common FOTD and techniques generator were included in the IDECM RFCM EMD contract. USAF has selected components of IDECM RFCM for integration into the B-1B Defensive System Upgrade Program architecture, and is planning integration of IDECM components into F-15 ALQ-135 Tactical Electronic Warfare System architecture.

In 1998, the IDECM program was re-baselined to fund an 87 percent development cost overrun and extend the development schedule by six months. Again, in April 1999, technical difficulties and cost overruns resulted in a second restructuring of the IDECM program by PEO(T). The resultant, new IDECM development strategy is a three phased, sequential approach intended to meet early operational deployment requirements and reduce risk of the development of the originally intended final IDECM suite. The three phases are:

Block I. IDECM Block I, is an interim F/A-18 E/F self-protection jamming suite consisting of the ALQ-165 (Advanced Self-Protection Jammer) and the ALE-50 Advanced Airborne Expendable Decoy. The Navy plans to use the IDECM Block I configuration for the first two F/A-18 E/F operational deployments only. IDECM Block I includes the five basic ASPJ WRAs (two receivers, two transmitters, and one processor), all upgraded through either Navy sustainment efforts and/or Foreign Military Sales (FMS) derived upgrades. The upgrades include FMS preamps (to improve receiver performance), a RF tunable filter (to improve ASPJ interoperability with the AI radar), and a new threat parametric User Data File.

Recalling that ASPJ was cancelled in 1992 after an unsuccessful OPEVAL, the path to becoming a component of IDECM Block I warrants brief review. Though cancelled, approximately 100 ASPJ systems had already been procured by the Navy for the F-14D. Contingent upon satisfactory performance in an FOT&E of the F-14D, the Navy was allowed to field the system. Subsequently, in 1995, ASPJ offered the only rapidly available capability to improve F/A-18 C/D survivability against threats in the Bosnia/European theater of contingency operations. The Navy was allowed to procure 36 additional, improved ASPJ systems (made possible through an approved FMS program that kept the production line open). ASPJ development was consistently overseen by DOT&E throughout this evolution.

As mentioned above, in April 1999, IDECM technical challenges and schedule constraints led to a Navy decision to develop an on-board RF jammer to support initial F/A-18E/F deployments. F/A-18E/F was specifically designed and equipped to carry IDECM, with backwards compatibility for ASPJ as the on-board jammer. It was not economically feasible to modify the aircraft to carry another self-protection jammer. The Navy began integration of the first of the three-phase program to incrementally develop an on-board and off-board RF jammer system for F/A-18 E/F, with the first phase (IDECM Block I) using an upgraded variant of ASPJ. As stated earlier, the Navy intends the development and deployment of the IDECM Block I system as an interim capability until Blocks II and III successfully conclude their developmental and operational testing. An important aspect of this interim solution is the fact that the Navy did not procure logistics supportability for IDECM Block I beyond that necessary to field the system on the first two deployments.

Block II. IDECM Block II, a second interim configuration, will be comprised of the ALQ-214 (includes the on board jamming capability) and the ALE-50 towed decoy. This configuration is planned for the third F/A-18 E/F deployment.

Block III. IDECM Block III will be the final configuration, and will be comprised of ALQ-214 RFCM and ALE-55 FOTD. IDECM Milestone III is scheduled for 3QFY02. OPEVAL for IDECM integration with the Common Missile Warning System (CMWS) is planned subsequent to the CMWS MS III. CMWS integration in the F/A-18E/F will be supported through the IDECM Integration Milestone III in FY03. IDECM Block III will support the fourth and subsequent operational deployments of the F/A-18 E/F.

On a parallel schedule, the Navy conducted the F/A-18E/F OPEVAL from 3QFY99-1QFY00. Since F/A-18E/F OPEVAL was conducted before the more capable IDECM RFCM was available, F/A-18 E/F OPEVAL aircraft were not equipped with IDECM RFCM. It was equipped with the ALE-50 Launch Controller/Dispenser portion of IDECM Block I, including AAED, to fill part of the self-defense requirement in support of overall F/A-18E/F OPEVAL survivability assessment. DOT&E required the Navy conduct a separate Block I OT, which concluded in August 2000. F/A-18E/F FOT&E with IDECM RFCM is planned concurrently with OPEVAL for the RFCM, supporting RFCM Milestone III and B-LRIP in FY02.

TEST & EVALUATION ACTIVITY

IDECM Block I DT, Sep 99 through Feb 00, tested ASPJ installation, effectiveness and suitability on the F-18 E/F to include compatibility with other self-protection systems (ALE-50, ALE-47, and ALR-67(V3). The successful initial DT of IDECM Block I led to a combined DT/OT test, March to April 2000. In May, the Operational Test Readiness Review moved the program forward into dedicated OPEVAL. The program completed a four-month OPEVAL in August 2000. The operational effectiveness criteria for IDECM Block I was that it provide a measurable reduction in lethality for the

Block I equipped F/A-18 E/F as compared to an ALQ-126B equipped F/A-18 C/D.DT and OT included rigorous ground and flight test which included hardware-in-the-loop simulations and flights involving actual threat systems. COMOPTEVOR is finalizing test documentation and system assessment that DOT&E will follow with a BLRIP report evaluating test adequacy and confirmation of effectiveness and suitability. Since no new ASPJ systems are to be procured, the effect of the report is to comply with Title 10 requirements for operational test of the IDECM system, Block I version only, prior to deployment to the fleet.

IDECM Block II completed a limited DT Assist by operational test personnel in 4QFY00. The results indicated positive progress towards a Block II fielding in the third F-18E/F deployment in August 2003. Block III completed a limited (no on board transmitters) Operational Assessment (OA) in March 2000 where it was assessed to be potentially operationally effective and suitable.

The IDECM Block III RFCM OA was conducted in two phases. A hardware-in-the-loop (HITL) test versus a realistic threat system was carried out November 1999. The aircraft, missile flight path, and environmental effects were modeled using an uninstalled RFCM and FOTD to counter a missile in a radar anechoic chamber. The second OA phase was flight testing at NAWC-WD China Lake's Electronic Combat Range, carried out from February-March 2000. This test phase was an early look at the potential operational effectiveness and suitability of IDECM. By design, the test was limited to a non-production representative installation on the ATB aircraft using a reel-out, reel-in external pod to conserve decoys.

Test and evaluation activity of Block III during FY00 was beset by continued technical difficulties with the FOTD, and FOTD launcher assembly. Early developmental testing revealed that FOTD flight envelope and IDECM component interoperability issues were more difficult than expected. System development was at a much slower pace than expected, and led to a delay in the OA flight test until 2QFY00. Fast deploy (a rapid release and reel out to a specific distance behind the aircraft) testing was carried out on several platforms throughout FY00: Lear, Drakken (for early development work), F-16, F/A-18 E/F, and F-15. All aspects of system mechanical and electrical performance were evaluated. To resolve safety of flight issues caused by FOTD fins striking the underside of the aircraft, a fin delay mechanism was developed and entered into test. Developmental flight testing continued sporadically throughout the beginning of the fiscal year, slowing during the RFCM OA. System software and software integration appear to be on track, with two major blocks of software delivered this FY on or ahead of schedule. However, due to the by-design deployment of the FOTD in the area of the engine plume, the F/A-18 E/F continues to be the most difficult platform for IDECM. To characterize the thermal environment behind the aircraft, tests were conducted with a Tiger pod that uses a towline with embedded thermocouples. Early results showed unexplained temperature spikes in the towline.

Several efforts were made to improve decoy deployment and retention on the F-18E/F. Materials research studies on new fiber optic and towline strength member materials were continued, looking for materials that will improve the thermal and mechanical limits of the current towline. In addition, two efforts to improve the current version of the reel-out, reel-in pod for test use were begun. These improvements are needed to improve the rate of decoy re-use and expand the flight envelope over which the decoy can be tested.

The only approved TEMP is dated April 1999. It was approved by DOT&E with the condition that it was valid only through the IDECM RFCM OA and that the TEMP will be updated prior to the next test event. An Annex to the TEMP covering all Block I test efforts was approved in March 2000. The TEMP IPT is currently updating the capstone TEMP to include the complete three-phase approach to IDECM development (described above), testing, and introduction to the Fleet.

TEST & EVALUATION ASSESSMENT

The new three-phase development strategy and test planning have successfully mitigated some of the risk incurred over the last two years of IDECM evolution. As mentioned earlier, Block I is presently on track to support the first two F-18E/F deployments. The IDECM Block I test effectively re-baselined survivability of the F/A-18E/F. The limited nature of the supportability of the end product, however, is cause for some concern. The Navy has not sought to change or extend the ASPJ logistics support structure. The IDECM Block I system, by virtue of being an interim solution intended only for the first two F/A-18E/F deployments, has limited logistic supportability for the fleet. Follow-on IDECM blocks must produce an effective and suitable replacement to the Block I suite before its available logistics support expires. Block II successfully completed DT; recall, though, that operational test of Block II (including ALQ-214 RFCM, on board jamming, and ALE-50 towed decoy operation) is yet to be conducted.

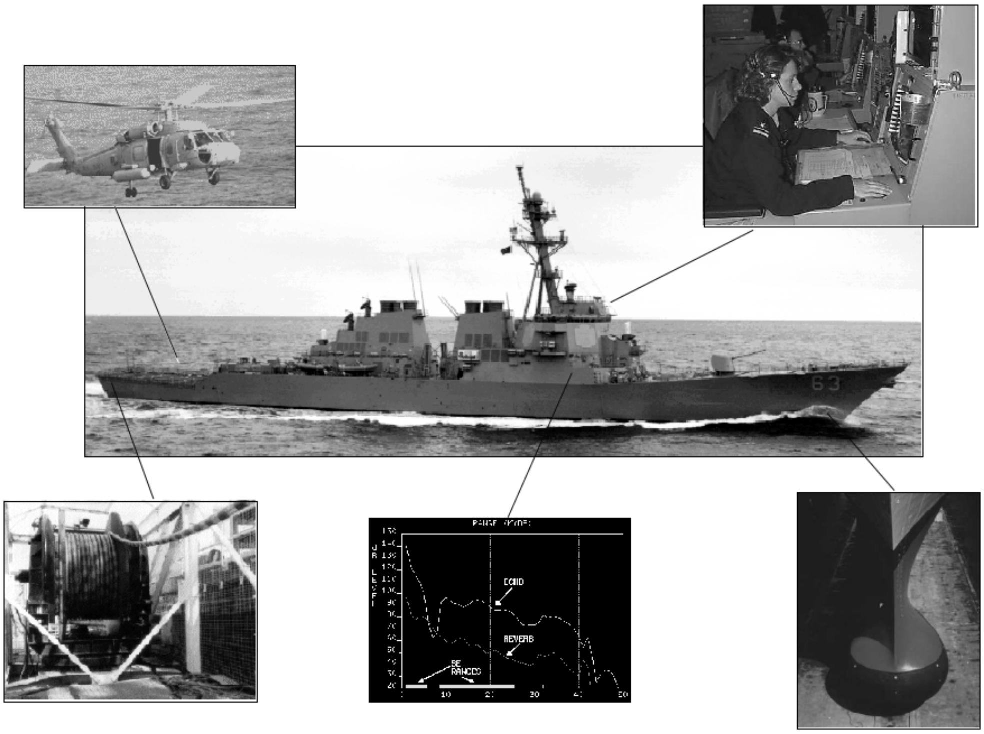
Block III, with particular regard to the FOTD, towline, and deployment design, is still high risk. In the lab environment, the Block III RFCM and FOTD proved to be a highly effective system in numerous scenarios. Results in the OA HITL tests versus the realistic threat system were very positive and also very close to predicted results. Once the flight envelope in which the system could successfully deploy and maintain fiber optic continuity was determined, the IDECM OA flight test was successful. The results of the test proved – in the very limited maneuver, altitude, and airspeed regime explored – that the RFCM and FOTD could be effective against several distinctly different types of SAMs. However, the hardware and software installations were non-production representative and, therefore, little could be determined in the OA about suitability. Furthermore, reel-in/reel-out and towline improvements are not complete.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

Several test range limitations hampered all blocks of IDECM testing. Threat simulators intended for use during the RFCM OA were not operational. One new test asset, the “Missile on a Mountain,” used for testing a particular class of missiles, did not produce consistent miss distance data. Daily alignment variations of several of the threat simulators made analysis and interpretation of the results difficult. Furthermore, only a small number of threat assets available have accredited fly-out models that work in real time profiles. The Navy needs to invest in these test assets, to include valid fly-out models and accreditation of as many threats in the IDECM threat matrix as possible, in order to produce operationally relevant and credible T&E results for Block II and Block III variants.

With regard to the IDECM development strategy, the Navy needs to continue developmental efforts to produce a reliable IDECM system, solve decoy launch/flight envelope issues, and gain further insight on towline characteristics and failure conditions. The Navy needs to mitigate the risk that Block III will not be available for the fourth and subsequent F-18E/F deployments (January 2004 and beyond). Understandably, the service desires to plan for the success of the Block III program. However, a prudent plan must include an operational test of the Block II system, which would necessarily begin in FY01 with an early decision (i.e. at least prior to the beginning of OPEVAL) to do so. A rigorous and comprehensive operational test of the Block II configuration is required before fielding the system for interim use (the third F/A-18 E/F deployment), much less as what may turn out to be the final installment in F/A-18 E/F self-protection.

INTEGRATED SURFACE SHIP ASW COMBAT SYSTEM (AN/SQQ-89)



Navy ACAT IC Program

Total Number of Systems:	144
Total Program Cost (TY$):	$7097.3M
Average Unit Cost (TY$):	$39.3M
Full-rate production:	3QFY94

Prime Contractor

Lockheed Martin

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The AN/SQQ-89 (V) is an integrated ASW combat system combining improved sensors and weapon control systems with advanced acoustic data processing and display. The system integrates the AN/SQS-53B/C/D hull mounted sonar, the AN/SQR-19 (V) Tactical Towed Array Sonar and the AN/SQQ-28 (V) LAMPS MK III Shipboard Electronics with the ASW Control System (ASWCS) MK 116 MOD 5/6/7/8/9. It supports the ***Joint Vision 2020*** concepts ***of full-dimensional protection*** and ***precision engagement*** by providing long-range detection, tracking, localization and correlation of surface and sub-surface contacts and engagement of sub-surface contacts via the ship's Combat Direction System or Command and Decision sub-system. Various combinations of the AN/SQS-53B/C/D, the AN/SQR-19 (V), the AN/SQQ-28 (V) and the MK 116 constitute the AN/SQQ-89 variants installed in the CG 47, DDG 51, and DD 963. Only combinations of the AN/SQR-19 (V) and AN/SQQ-28 (V) are included in the AN/SQQ-89 (V) variants installed in the FFG 7 class. The AN/SQQ89 (V) 6 is the baseline system for towed array ships and underwent OPEVAL in 1994.

The baseline AN/SQQ-89 (V) system is being modified. The program office is backfitting several Commercial-Off-The-Shelf (COTS) engineering changes into in-service ships and will forward fit additional changes into future combatants. The change evaluated in FY00 testing was the AN/SQQ-89(V)6 Torpedo Alertment Upgrade, which includes installation of the Torpedo Recognition and Alertment Functional Segment (TRAFS), (formerly called Multi-Sensor Torpedo Recognition and Alertment Processor) and operability improvements such as the System Level Recorder, the Tactical Decision Support Sub-system, a COTS-based Sonar In-situ Mode Assessment System and a Common Integrated Tactical Picture capability.

BACKGROUND INFORMATION

SQQ-89 integrates individual and operationally tested major components. These major components were all determined to be operationally effective and suitable. In FY90, DOT&E suggested the creation of a TEMP to operationally test the integrated SQQ-89 system with the first TEMP approved by OSD in 1991.

Previous testing of the AN/SQQ-89 system (OT-IIIF) was completed in June 1994 in conjunction with platform level FOT&E of the DDG 51 class guided missile destroyer. Overall, DOT&E assessed the AN/SQQ-89 (V) 6 ASW combat system installed in the DDG 51 class ship to be operationally effective and operationally suitable. However, when faced with an attacking submarine in a one-on-one encounter, the 1994 baseline system did not afford a survivability advantage to the surface combatant.

The Torpedo Recognition and Alertment Functional Segment (TRAFS) began as a standalone system as part of the Surface Ship Torpedo Defense program, and was not subject to DOT&E oversight. It underwent OPEVAL in 1997, designated OT-III. In its report, COMOPTEVFOR concluded that the standalone system was operationally effective for DD 963 class ships with a specific acoustic sensor not operationally effective otherwise. Additionally, the system was found to be not operationally suitable due to severe software reliability problems. COMOPTEVFOR did not recommend the standalone system for Fleet introduction.

In response to the OT-III results, the program's sponsor, the Director of Surface Warfare (CNO N86), issued a letter in 1998 which stated the program was working to correct the deficiencies and authorized new construction and backfit installations of the SQQ-89 (V) 6 with a fully integrated TRAFS. The letter also concurred with the need for follow-on operational testing. At that time, TRAFS came under DOT&E oversight because it was now integrated into the AN/SQQ-89 program.

In June 1999, the integrated TRAFS, under the designation AN/SQQ-89(V)6 Torpedo Alertment Upgrade, underwent DT-IIIAN aboard USS PORTER (DDG 78) as part of that ship's Combat System Ship Qualification Trials. A January 25, 2000 Operational Test Readiness Review for OT-IIIG reviewed the results of DT-IIIAN and cited failure to meet the ORD-specified false alarm rate and reliability thresholds. The program office responded that the false alarm problem was corrected through enhanced operator training while the reliability problem was corrected with a certified patch to the software. As a result, the system was certified ready for test.

During 1999, the Navy, at the urging of DOT&E, worked on revising the 1990 ORD, which focused on Cold War scenarios. The ORD was also intended to reflect the subsequent shift to littoral and regional threats and the evolving series of upgrades to the SQQ-89 program. Because there was insufficient time to route the ORD for approval prior to OT-IIIG, the TEMP was updated to reflect proposed ORD requirements based on informal concurrence on the part of the key signatories, including DOT&E. However, since the conclusion of OT-IIIG in February 2000, the Navy has still not completed the ORD approval process.

TEST & EVALUATION ACTIVITY

The AN/SQQ-89(V)6 underwent FOT&E, designated OT-IIIG, from January 31-February 3, 2000, at the Atlantic Undersea Test and Evaluation Center (AUTEC), off Andros Island, Bahamas. The testing focused on TRAFS, but other sub-systems of the SQQ-89 (V) 6 Torpedo Alertment Upgrade were tested, including the Tactical Decision Support System, the Sonar In-situ Mode Assessment System II, and the System Level Recorder. In keeping with SECDEF testing themes of combining DT/OT and training, OT-IIIG was conducted concurrently with a DT for the Submarine Combat Control System Mk 2 and a submarine Tactical Readiness Evaluation.

The purpose of OT-IIIG was to determine the operational effectiveness and operational suitability of the SQQ-89 (V) 6 Torpedo Alertment Upgrade and its readiness for Fleet introduction. The test ship, USS PORTER, conducted assorted warfare tasks over the course of a 3-day period while under the constant threat of potential torpedo attack. This required a certain degree of vigilance be maintained around the clock. The test schedule was designed to avoid regular patterns of firings or other clues that might lead to unrealistically high levels of operator alertment, including a torpedo launch from a surface craft. This provided a fair assessment of the system under expected operational conditions. A total of 14 torpedoes were fired, resulting in 13 valid events. Overall, OT-IIIG represented a realistic and challenging test.

TEST & EVALUATION ASSESSMENT

COMOPTEVFOR's final report on OT-IIIG concluded that the SQQ-89 (V) 6 Torpedo Alertment Upgrade is neither operationally effective nor operationally suitable, and is not recommended for Fleet introduction. Sixteen major deficiencies were noted, including excessive false alert and false alarm rates and poor software reliability. On June 15, 2000, in response to the COMOPTEVFOR final report, the Commander, Naval Surface Forces Atlantic immediately suspended all future installations of the AN/SQQ-89 (V) 6 Torpedo Alertment Upgrade on Surface Force Atlantic ships. The suspension will remain in effect until all major discrepancies listed in the final report are certified corrected by COMOPTEVFOR and all current ship installations are corrected. Based on independent analysis of the test data, DOT&E concurs with COMOPTEVFOR's overall findings and the action taken by the Commander, Naval Surface Force Atlantic. Specific test results and DOT&E analyses are provided in the classified annex to this Annual Report.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

Based on OT-IIIG and previous observations from earlier tests and exercises, the Torpedo Alertment Upgrade does not enhance torpedo alertment and evasion over the legacy system. There is some evidence that, under operational conditions, it may serve to degrade operator performance. Fleet experience indicates operators will turn a system off rather than listen to incessant alerts. If sonar operators are properly trained and attentive, they may detect some of the threat themselves, without TRAFS. If the Fleet sees TRAFS as an opportunity to lower manning or training requirements for sonar technicians, the resulting operators are unlikely to be able to make effective use of the information provided by TRAFS. It is not clear that there is a simple solution to the TRAFS alert problem, and the entire concept may require extensive revision and redevelopment in order to be truly effective. Finally, TRAFS testing reinforces the dependence of torpedo alertment capability on appropriate sensors.

The larger "ship survivability/torpedo evasion" Measures Of Effectiveness cannot be answered through SQQ-89 program testing alone. Complete, in-water, end-to-end testing of torpedo evasion using countermeasures and evasion tactics outside the bounds of the SQQ-89 program is essential and intentions are for this testing to be conducted as part of DDG 51 class FOT&E. However, the next three SQQ-89 variants: (V)10, (V)14, and (V)15 will be built without towed arrays. Even though SQQ-89 testing is being integrated into DDG 51 FOT&E, DOT&E strongly believes the Navy must follow through with updating the SQQ-89 ORD to reflect current and future operational environments and threats.

JOINT COMMAND AND CONTROL CAPABILITY (JCC(X))

Navy pre-MDAP Program		Prime Contractor
Total Number of Systems:	N/A	TBD
Total Program Cost (TY$):	N/A	
Average Unit Cost (TY$):	N/A	
Full-rate production:	N/A	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

JCC(X) is the Navy's proposed replacement capability for the current four aging command ships, to provide Joint Force Commanders, embarked component commanders, Maritime Commanders, and staffs with enhanced mission capability for joint campaign battle management employing advanced C4ISR. The details of how the required capabilities will be provided are currently being studied in an Analysis of Alternatives (AoA). Candidate configurations include Joint Command and Control (JCC) functions aboard: 1.) dedicated built-for-the-purpose or converted ships, 2.) distributed among a number of platforms, or 3.) in combination with ashore facilities to provide a reach back capability for the on-site force commander.

JCC(X) will play a pivotal role in achieving the Joint Vision 2020 concept of ***information superiori****ty* and Joint Command and Control, enabling ***dominant maneuver*** and ***focused logistics*****.**

BACKGROUND INFORMATION

The Navy currently operates four dedicated command ships, which have been in service for 27 to 36 years. These ships also serve as the flagships for four of the five numbered fleet commanders. The replacement ship class will operate in much different combat operational environments from those for which the existing ships were built. The information revolution is changing operational concepts for military and naval forces, and U.S. forces operations are now required to be joint-interoperable, as well as increasingly interactive with allied and coalition forces and non-defense agencies and organizations. The JROC validated the Mission Need Statement for JCC(X) in September 1999, and USD(AT&L) granted Milestone 0 approval in November 1999.

OSD guidance for the JCC(X) Analysis of Alternatives (AoA) calls for a two-part assessment. Part 1, which has been completed, addressed whether an afloat command capability will be needed in the future. The OSD Overarching-Integrated Product Team has endorsed the Part 1 findings that:

1. an afloat JCC capability will be an essential element of robust operational-level command and control for joint operations in the future, and,
2. the mix of dedicated and distributed JCC capabilities should be examined further in Part 2 of the AOA.

Part 2 of the AOA is now in progress and will be completed in time to support the Milestone I DAB program decision anticipated in early FY 2002. This assessment is considering the required C4ISR operational functions and system architecture, and the possible ship and ashore options and characteristics in order to develop appropriate alternatives. The assessment of alternatives will examine specific scenarios and associated costs of the alternatives, including off-ship and/or ashore activities needed to provide the necessary JCC capabilities. The Milestone I DAB will review the basis of the required capability developed during the current concept formulation phase.

TEST & EVALUATION ACTIVITY

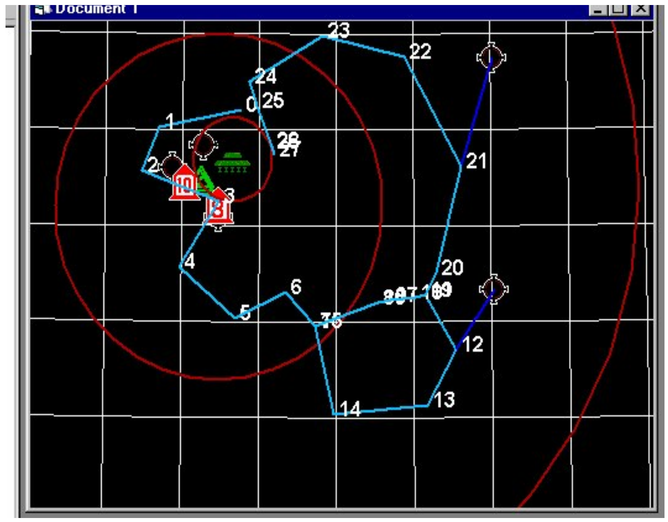
DOT&E has participated in the Joint Oversight Group discussions of the AOA, but the immaturity of this program has not permitted specific test and evaluation activity. It is anticipated that a preliminary version of the Test and Evaluation Master Plan (TEMP), as well as other supporting documentation, will be approved prior to the Milestone 1 DAB decision.

TEST & EVALUATION ASSESSMENT

If the results of the AoA suggest the joint command capability be distributed between the ship and other facilities afloat and ashore, the JCC capability itself will contribute only a partial-response to the overall C4ISR task requirements. Determining the effectiveness of the integrated command and control systems entity and the contribution of the JCC(X) within that structure will be a substantial challenge; and, it will require evaluation of the distributed elements of C4ISR as well as the JCC(X). Evaluating the suitability, effectiveness, and survivability of any facility and/or platform, which will house the JCC(X), will be a further challenge.

Interoperability among the elements of the integrated command and control system, that includes JCC(X), must be tested in a realistic operational environment, and the interoperability of the ashore and afloat C2 entities, with subordinate and superior levels of command, must be similarly evaluated.

JOINT MISSION PLANNING SYSTEM (JMPS)



Air Force and Navy ACAT IAC Program

Total Program Cost (TY$):	$179+M
Average Unit Cost (TY$):	N/A
Full-rate production:	
Verson 1.0 (basic mission planning):	Beginning FY02 (incremental)
Combat Planing (for various aircraft):	Beginning FY02 (incremental)
Strike/Force Level Planning:	TBD (incremental)

Prime Contractor
Logicon

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Joint Mission Planning System (JMPS) will provide basic mission planning capability for support of military aviation operations. It will provide support for unit-level mission planning of all phases of military flight operations. It will have the capability to provide necessary mission data for the aircrew and will also support the downloading of data to electronic Data Transfer Devices (DTDs) for transfer to aircraft and weapon systems. JMPS will evolve to support Air Force, Navy, Marine Corps, and U.S. Special Operations Command fixed and rotary wing aircraft, weapons, and sensors, including precision guided munitions, cruise missiles, and unmanned aerial vehicles.

As a command and control enhancement, JMPS will incorporate improvements in information and systems integration technologies to provide collaborative inter-Service mission planning capabilities. JMPS contributes to ***information superiority*** and supports all ***Joint Vision 2020*** operational concepts: ***dominant maneuver, precision engagement, focused logistics,*** and ***full-dimensional protection***.

JMPS is a cooperative development between the Air Force and Navy. It will evolve using the spiral development process for expansions of mission planning capabilities. JMPS builds initially on the functionality of the existing Portable Flight Planning Software (PFPS) currently used by all the Services. JMPS Version 1.0 provides capabilities for basic flight planning. Once the basic mission planning capability is in place, components of the Navy Tactical Automated Mission Planning System and the Air Force Mission Support System are to be migrated into JMPS. Later versions provide expanded capabilities to support combat mission planning, more complex aircraft and missions, and provide strike/force level planning capabilities.

JMPS will comply with the requirements of the Defense Information Infrastructure Common Operating Environment (DII/COE), as applicable to Windows 2000, with an initial framework architecture compliance of Level 6 and a goal of evolving to Level 7. Hardware is to be provided separately by each Service and will principally consist of commercial off-the-shelf computers ranging from laptops to desktop systems to multi-processor workstations depending upon the need for supporting specific weapon systems.

A JMPS for a specific aircraft type will consist of a Joint Mission Planning Environment (JMPE), which includes the operating framework, common software components and a basic mission planner mated with a software module called a Unique Planning Component (UPC). UPCs are to be provided primarily by aircraft programs and computer hardware are to be provided by the Services. The planning suites for some aircraft types will also include hardware for preparing DTDs.

BACKGROUND INFORMATION

The JMPS program was begun in 1997. Following a competitive design study, Logicon was selected to develop the JMPE framework and common component software. Logicon is also delivering a Generic UPC and a Software Development Kit that can be used by independent developers to develop aircraft-specific and other common UPCs.

Development is proceeding in a series of five Beta releases, each with added functionality and culminating in the full functionality of a basic mission planning system in 2002. The basic capability will be augmented with UPCs to create planning systems to support initial user aircraft. It is these individual JMPS suites, also referred to as Mission Planning Environments, that will undergo OT&E beginning in FY02. The initial planning systems for the Air Force will support the F-16 Block 30 and the B-52H. The JMPS for B-52H will provide basic route planning only, performing the role currently filled by PFPS. Routes will be exported from JMPS and imported into the B-52H's Air Force Mission Support System for addition of weapon delivery details and preparation of DTDs. The first Navy system will support the F/A-18.

TEST & EVALUATION ACTIVITY

DOT&E has participated in JMPS test planning from the program's outset. DOT&E approved a TEMP for the JMPS program in June 1999. At that time, mission planning operational requirements, the JMPS design, and the JMPS development schedule were not fully known. Consequently, test resource requirements, test design, and test implementation schedules could not be fully defined. An update to the TEMP was required within one year. However, an updated TEMP has not yet been submitted for OSD approval.

OT&E will consist of combined DT/OT, followed by dedicated OT&E of each JMPS suite. The DT/OT activity includes evaluations by the JMPS Test Team of each Beta release and feedback to the developing contractor. JMPS Beta 1 was released in April 2000 and Beta 2 was released in July 2000.

OT&E will be performed by each Service's OTA at the OTA's test site, followed by testing at field/fleet sites. Tests will include developing end-to-end mission plans and analyzing them for accuracy and usability. Field/fleet testing will include in-flight verification of JMPS products using test sorties and test crews.

OT&E for initial JMPS Version 1.0 systems is scheduled in the latter half of FY02.

TEST & EVALUATION ASSESSMENT

DOT&E's views of JMPS are based on attendance at program management reviews, participation in test planning working groups, and interviews with test team personnel.

Betas 1 and 2 provided elements of the JMPS framework and had minimum mission planning functionality. These first two Betas were released on schedule with no known high priority problems. Although the number of anomalies was significant, they are considered minor and did not detract from the objectives of the releases.

Development of Beta 3, which is to have an initial set of basic mission planning functions, is currently proceeding. Signs are emerging that software development problems will cause cost and schedule growth to the program. Additionally, as a software development program entailing over 200,000 lines of code, JMPS carries moderate to high-risk as to whether the system will meet the Services' expectations for functionality and ease of use. Significant risks are also associated with obtaining certifications for security, interoperability, and DII/COE compliance.

Many issues remain to be resolved before OT&E planning can be considered to be adequate. Services' user commands need to identify specific operational requirements for the initial JMPS planning suites that will undergo OT&E. The Air Force and Navy must completely define the activities and resources needed to integrate UPCs, obtain necessary certifications, and prepare initial planning suites for OT&E. DOT&E urges early resolution of these issues so that the TEMP can be updated and more definitive OT&E test plans can be prepared.

JOINT STANDOFF WEAPON (JSOW)

Navy-led ACAT ID Program

Total Number of Systems:	19,114
154A:	8,800 Navy; 3,000 AF
154B:	1,200 Navy; 3,114 AF
154C:	3,000 Navy
Total Program Cost (TY$):	$5,999.6M
Average Unit Cost (TY$):	
154A:	$.219M
154B:	$.361M
154C:	$.291M
Full-rate production:	
154A:	1QFY99
154B:	1QFY02
154C:	1QFY04

Prime Contractor

Raytheon, Tucson, AZ

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Joint Standoff Weapon (JSOW) is a family of kinematically efficient (~12:1 glide ratio) 1000-lb class, air-to-surface glide weapons that provide for low observability, multiple kills per pass, preplanned missions, standoff ***precision engagement***, and launch and leave capability against a wide range of targets during day/night, all weather conditions. All three JSOW variants employ a tightly coupled Global Positioning System/Inertial Navigation System (GPS/INS). JSOW is employed as a force multiplier in a joint warfare environment for interdiction of soft/medium fixed, re-locatable and mobile light and heavy armored targets, massed mobile armored targets, anti-personnel, and air-to-surface threats. JSOW primarily functions in a preplanned mission mode where the system can store up to eight (8) targets; however, the system will allow pilot manual inputs as well as third party targeting as long as the targeting system can meet JSOW's targeting requirements. The weapon will be both land and carrier based.

Mission planning will be accomplished using the Navy's Tactical Automated Mission Planning System (TAMPS) and the Air Force Mission Support System (AFMSS). Integration of operations with the Joint Mission Planning System (JMPS) is planned. JSOW will be employed on the following aircraft: F/A-18C/D, and E/F; F-16C/D (Blocks 50, 40, 30); F-15E; JSF; B-1B; B-2A; and B-52H. The weapon comes in three operational variants.

- AGM-154A (JSOW Baseline) – USAF and Navy: The payload of the AGM-154A consists of 145 BLU-97/B submunitions. The BLU-97/B is a combined effects munition. The bomblets have a shaped charge for an armor defeat capability, a fragmenting case for material destruction, and a zirconium ring for incendiary effects. JSOW Baseline is designed to conduct pre-planned attacks on stationary soft targets such as: air defense sites, parked aircraft, components of airfields and port facilities, command and control antennas, stationary light vehicles, trucks and artillery, and refinery components.

- AGM-154B – (JSOW BLU-108) - USAF and Navy: The payload for the AGM-154B is the BLU-108 submunition from the Air Force Sensor Fuzed Weapon (SFW). JSOW will carry six BLU-108s, each of which dispenses four warheads or skeets. The skeets carry an infrared or dual mode sensor, and upon detecting a target, detonate to create an explosively formed penetrator that impacts the target. This system is an interdiction weapon with a target set identical to the Sensor Fuzed Weapon (SFW), which consists of mixed units of tanks, infantry fighting vehicles/armored personnel carriers and trucks in a tactical road march formation.

- AGM-154C (Unitary Variant) – Navy only: The AGM-154C, in addition to the common INS/GPS guidance, will use an autonomous Imaging Infrared seeker for target acquisition and terminal guidance. The AGM-154C will carry the BAE multiple warhead system (Broach), and is designed to attack point targets such as industrial facilities, logistical systems, and shipping locations.

BACKGROUND INFORMATION

The JSOW program is incorporating a new Low Cost Control Section (LCCS) and Low Cost Guidance Electronics Unit (LCGEU) into all variants. This change is planned prior to final operational test and full-rate production decisions of AGM-154B and AGM-154C variants, but will be cut into the full-rate production of AGM-154A. In addition, JSOW is integrating the new GPS Selective Availability Anti-Spoofing Module (SAASM) security architecture into the LCGEU for delivery in fielded units in late FY03.

AGM-154A, Baseline Variant

Milestone III for the AGM-154A was October 1998. DOT&E observed Navy OPEVAL and Air Force IOT&E in FY97-98. During FY98, DOT&E performed an independent LFT&E assessment on the lethality of AGM-154A JSOW/BLU-97 based on data obtained from the BLU-97 Insensitive Munitions (IM) warhead characterization test, DT-IIC and OT-IIA live missile drops and OPEVAL live drops. The results of the assessment were included in the combined AGM-154A Operational and Live Fire Test & Evaluation Report to Congress.

In April 2000, material defects were discovered in the payload rails and were identified as safety of flight critical to the BLU-97 payload assembly of the JSOW AGM-154A (baseline) variant. The program office removed the AGM-154A JSOW from flight status. Subsequently, AGM-154A JSOW was released for restricted combat operations. The problem was identified and the corrective action to go to a new rail supplier was implemented and new rails began delivery in Jul 00.

AGM-154B, BLU-108 Variant

LRIP for the AGM-154B was granted 1QFY99. The AGM-154B Milestone III decision is currently scheduled for 4QFY01.

AGM-154B LFT&E is based upon live fire testing conducted for the Sensor Fuzed Weapon program. Due to delays in the SFW Preplanned Product Improvement (P^3I) program, the JSOW Joint Program Office funded the SFW program to develop a baseline BLU-108 warhead modified to incorporate an IM fill (PBXW-11 explosive). The PBXW-11 IM fill performance was equal/greater than the previous OCTOL fill BLU-108 warheads. The LRIP I buy of AGM-154Bs will use this interim risk reduction warhead until the P^3I warhead becomes available. The LRIP II (deliveries start in Aug 02) and subsequent FRP AGM-154Bs will incorporate the P^3I BLU-108. The P^3I warheads will also have the IM PBXW-11 fill.

AGM-154C, Unitary Variant

The AGM-154C LRIP is scheduled for 4QFY02; MS III is scheduled for 4QFY03.

DOT&E did not initially require LFT&E for the AGM-154C variant because the program office originally planned to use the BLU-111/B, a proven warhead. In September 2000, USD/AT&L approved incorporation of the developmental Broach warhead. Due to incorporation of the new warhead, LFT&E including system-level realistic lethality testing of the AGM-154C against threat representative targets is now required.

TEST & EVALUATION ACTIVITY

AGM-154A, Baseline Variant

Aircraft integration continues for weapons incorporating the new LCCS and LCGEU. In Aug 00, AGM-154A conducted end-to-end testing which included captive avionics integration missions and live launches from a F/A-18C/D, F-16 Block 50, and B-2A. The F/A-18C/D testing consisted of side-by-side launches of two AGM-154A weapons, one weapon configured with old control section and GEU, and one LCCS and LCGEU production verification test (PVT) weapon. During CY00, the B-2 launched four

JSOWs in a Force Deployment Evaluation (FDE) to certify their OFP and verify B-2 training and tactics. Three LRIP AGM-154As were launched. One FRP AGM-154A with the LCCS and LCGEU was successfully launched in September 2000. The last B-2 FDE shot demonstrated the B-2's ability to rapidly re-target the JSOW weapon just prior to launch.

GPS jamming testing was completed this summer with the F/A-18C/D.

AGM-154A weapons were successfully tested, aircrews trained and deployed with the 20 Fighter Wing (FW) to meet a Quick Reaction Capability (QRC) direction from CSAF.

AGM-154B, BLU-108 Variant

AGM-154B (BLU-108 submunitions) received approval from the Joint Safety Review Board (JSRB) for MOT&E and shipboard use. Validation of equivalent performance of the BLU-108 warhead with PBWX-11 IM fill vice the old OCTAL fill was completed using the baseline warhead configuration to support MOT&E. The validation testing for the complete P^3I BLU-108 design including a new warhead started in September 2000.

MOT&E environmental qualification for the AGM-154B began in March 2000. Operational flight testing was originally scheduled to begin in Dec 00, but is being delayed, probably until mid-2001.

During PVT-B testing on the F-16, LCCS BIT (motor fault) failures were reported when moderate aerodynamic buffet was encountered during several high speed, low altitude test points. All BIT failure indications cleared when the aircraft reached flight conditions where buffet subsided indicating no permanent weapon failure. However, the fault indications are within the performance specification limits for the JSOW in the F-16 launch and captive regions and are an operational issue. During investigation of the LCCS BIT failures, significant wear was noted on control fin pin locks and inserts.

Also, in an F-16 launch of an AGM-154B in September 2000 all control section moveable fins fully deflected just prior to release. After release, the weapon departed controlled flight and crashed.

Together, the LCCS BIT failures, control fin pin lock and insert wear, and the fin deflection problem are delaying the start of MOT&E and the final B-52 launch. An investigation is in progress.

AGM-154C, Unitary Variant

AGM-154C is scheduled to begin developmental testing in 3QFY01with an operational assessment in 3QFY02 and initial operational testing starting in 2QFY03.

TEST & EVALUATION ASSESSMENT

AGM-154A, Baseline Variant

The results of Navy OPEVAL and Air Force IOT&E confirmed that JSOW Baseline, AGM-154A, is operationally effective and suitable. Additionally, JSOW Baseline meets accuracy and lethality requirements when employed against fixed, soft, pre-planned targets. However, future operational testing must address end-to-end interoperability with targeting aircraft/joint forces using third party and self-targeting modes of operation. Self-targeting and third party targeting will be evaluated when launch platform-targeting systems and third party data source interfaces become mature. Third party timing will be assessed during operational testing of JSOW AGM-154B.

Fixes to the payload assembly rails material defects of the JSOW AGM-154A variant were identified and are being incorporated into all weapons. Combat restrictions are removed for all systems that have had their rails replaced.

Production Verification Testing (PVT) with an AGM-154A (PVT-A) and AGM-154B (PVT-B) was delayed due to software development for the LCGEU, and resolution of material defects with the dispenser rails. Results from F-18 launched PVT-A side-by-side and additional PVT weapon launches are being used to evaluate any effects on the performance of AGM-154A due to the new LCCS and LCGEU. A recent F/A-18C/D side-by-side launch of a AGM-154A with the older control section and an AGM-154A with the LCCS (and LCGEU) showed no discernable difference in performance between the two configurations. Terminal end-game maneuvering and weapon accuracy of the new Low Cost Guidance Electronic Unit (LCGEU) and Low Cost Control Section (LCCS) was demonstrated to be similar to the previous LRIP weapons during the dual launch from the F/A-18C/D. The AGM-154A Production Verification Tests also demonstrated performance within GPS jamming environments.

AGM-154B, BLU-108 Variant

Delays in the P3I submunition development affected the planned cut-in date for P3I into both Sensor Fuzed Weapon and Joint Standoff Weapon, and will result in the procurement of fewer P3I versions of these weapons. The delays led the JSOW AGM-154B program to plan initial production with the BLU-108C/B IM filled submunition, which lacks P3I improvements. Follow-on operational testing of the AGM-154B will be accomplished when the BLU-108 P3I warhead completes SFW P3I LFT&E and FOT&E and is available from production. The SFW risk reduction testing of the interim BLU-108 with the insensitive munitions (PBXW-11) fill has been completed. Awaiting analysis and reporting of test results.

During investigation of LCCS BIT failures on the F-16, testing on an F/A-18C/D under similar flight conditions indicated satisfactory performance of the weapons during captive carry. The contractor has reproduced this BIT false alarm indication with a LCCS in the vibration laboratory and is working corrective action.

The AGM-154B flight test failure on launch from the F-16 is also currently under investigation. Although the failure is a JSOW air vehicle failure and is not specifically related to the type of payload that it was carrying (BLU-108s in this case), this is a significant event because it affects all variants. Failure analysis is in progress. The F-16 launch failure was preceded by successful AGM-154A launches from F/A-18C/D and B-2 aircraft. These weapons were configured with the same LCGEU, LCCS, and 8.1.4 guidance software.

The LCCS Fin Motor BIT fail indications and control fin pin lock and insert wear observed during F-16 captive carriage and F-16 launch failure have impacted the start of AGM-154B MOT&E, now to be determined pending the outcome of the investigation.

Operational Use

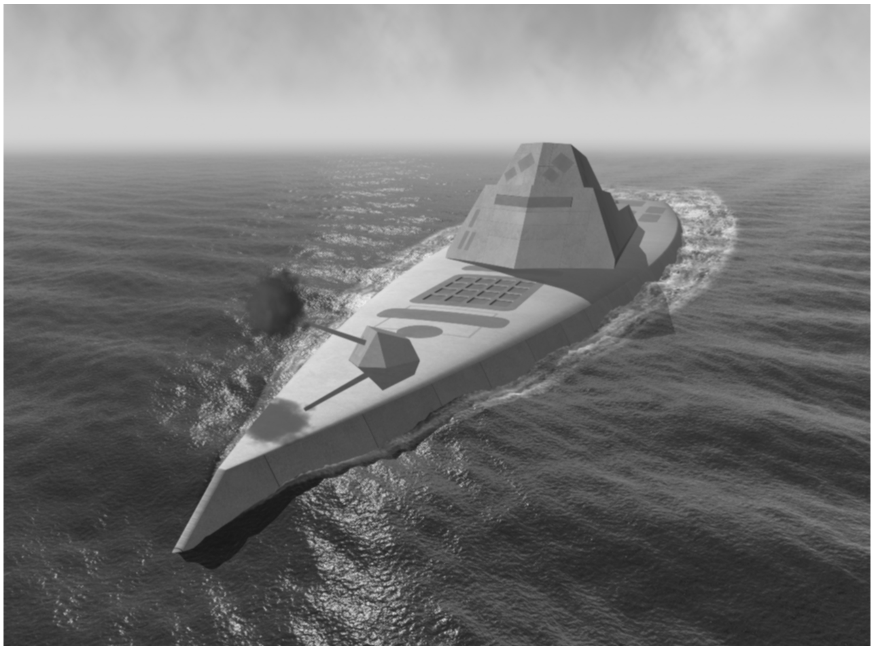
As of September 2000, 66 AGM-154A weapons have been employed against fixed and relocatable targets in combat operations in Operation Southern Watch and Operation Allied Force.

Battle damage accuracy assessment estimates exceed requirements for the weapon dispensing over the planned target area.

LESSONS LEARNED

JSOW production issues have occurred, and the JSOW Program Office demonstrated a capability to rapidly address and resolve these issues. A BLU-97 payload rail-manufacturing defect was detected during the manufacturing process, which had safety of flight implications. A new rail supplier was rapidly qualified and a rail retrofit program was implemented with minimal impact to operational capability. No JSOW weapon had experienced a failure of this component during flight test or operational use.

LAND ATTACK DESTROYER (DD 21)



Navy ACAT ID Program		**Prime Contractor**
Total Number of Systems:	32	TBD
Total Program Cost (TY$):	$50,304.9M	
Average Unit Cost (TY$):	$1,359.4M	
Full-rate production:	2QFY13	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Land Attack Destroyer (DD 21) is the first in a family of Twenty First Century Surface Combatants (SC 21). It will provide independent forward presence/deterrence and operate as an integral part of Naval, Joint, and Combined maritime forces. Tailored for land attack, DD 21's mission is to carry the war to the enemy through offensive operations. It will contribute to ***Joint Vision 2020*** through ***precision engagement*** and ***dominant maneuver*** by conducting littoral operations that include firepower support for amphibious and other ground forces and the launch of precision strike weapons. DD 21 will also provide friendly forces ***full dimensional protection*** from enemy attack through the establishment and maintenance of surface and undersea superiority and local air defense. Signature reduction is to be incorporated into the DD 21 design, allowing it to operate in all threat environments. DD 21 is the numerical replacement for retiring Spruance (DD 963) class destroyers and Oliver Hazard Perry (FFG 7) class frigates, which will reach end of service life during the 2005-2007 timeframe.

In early FY00, the Navy announced that DD 21 will be powered by electric drive and will feature an integrated power system. The integrated power system design will allow sharing of electrical power between propulsion motors and other uses. Another identified DD 21 feature is the Advanced Gun System, which will meet land attack and surface mission requirements. Each Advanced Gun System will consist of a single-barrel 155mm gun supplied by an automated magazine that will carry a family of long-range land attack and surface projectiles.

BACKGROUND INFORMATION

During Phase I of the acquisition strategy, which concluded in October 1999, two industry teams performed requirements analyses and trade studies to develop competing DD 21 system concept designs. In November 2000, the competing teams delivered DD 21 system preliminary designs and Smart Product Models that include virtual prototypes of the DD 21 system. The government will select a single design at the end of Phase II. After downselect, the winning Full Service Contractor will complete the DD 21 design; build (at both competing shipyards), conduct DT, deliver DD 21 and provide life-cycle support.

During 4QFY98, DD 21 LFT&E performed a successful Weapon Effects Test against ex-USS RICHMOND K. TURNER (CG 20). The objectives of the this test were to generate weapon effects data needed for the improvement and validation of damage models and to demonstrate real threat weapon damage on Navy ships to industry designers. Weapon effects data collected from this test will be used to validate damage models, which will be used for the design and vulnerability assessment of DD 21. The post-test exhibition and documentation of the damage provided a valuable data base for the survivability design of DD 21.

DOT&E approved both the Milestone I TEMP in FY98 and Change 1, which included an updated LFT&E strategy, in FY99.

TEST & EVALUATION ACTIVITY

DOT&E participated in the DD 21 Test and Evaluation Working Integrated Product Team throughout FY00 and attended the competing industry team's program reviews. DOT&E reviewed industry team test and evaluation documents and provided assessments of their adequacy to the Program Manager. DOT&E assisted the Program Manager and OPTEVFOR with preparation of the first major TEMP revision, which incorporates revised OT and LFT&E strategies as well as schedule adjustments (Milestone II in 1QFY04 and IOC in 2QFY11) and funding re-alignment to reflect POM 02 inputs and accommodate advanced procurement budgeting. The revised TEMP was approved by DOT&E in September 2000, with the requirement to complete another revision of the TEMP within six months after the March 2001 downselection to one Full Service Contractor. DOT&E also assisted the Program Manager in developing Change 1 to the LFT&E Management Plan, which was approved in July 2000.

The DD 21 Program completed two significant LFT&E testing efforts during FY00. The ex-USS DALE (CG 19) was used for an advanced weapons effects test to collect data on ballistic damage that results when a missile impacts a ship. This test program represents the most extensive data collection effort ever conducted for missile attacks against actual ship structure. At DOT&E's suggestion, the Navy included combustible material in some of the attacked spaces for one of the two tests. The test confirmed the devastating effects of weapons-induced fires and the significant impact on crew access and fire spread caused by door, sheet metal structure, and escape trunk failures and fire and blast propagation through ventilation systems. Another testing effort, part of the Navy's Magazine Protection work, examined the reaction propagation behavior and internal blast yield of large missile booster motors when directly and indirectly attacked by weapons effects. In addition, DOT&E/LFT&E senior leadership has provided both Blue and Gold Team senior leadership with LFT&E tutorial and dialogue.

TEST & EVALUATION ASSESSMENT

After the March 2001 downselect, the first of two EOAs will be conducted to provide the first in-depth look at the potential effectiveness and suitability of the winning design. The EOAs will be performed by a team comprised of subject matter experts from Navy Systems Commands, the Naval Surface Warfare Center and user representatives from OPTEVFOR, MCOTEA, and the fleet. This team will apply its wealth of experience in a thorough review of program documentation, modeling and simulation results, and data from technical and developmental testing. The second EOA will be conducted in FY03 to update the assessment prior to Milestone II.

In a significant departure from operational testing of earlier combatants, the revised TEMP introduces a two-phase operational evaluation of the first ship that will span a period of more than one year and draw data from the lead ship's first operational deployment. DOT&E supports OPTEVFOR's assessment that DD 21's advanced technologies, reduced manning, and unique Full Service Contractor support concept warrant an extended examination of DD 21 operations and logistics support. However, the extended OPEVAL concept will require further clarification in the next TEMP revision to ensure operational testing is adequate to support an independent assessment of operational effectiveness and suitability prior to the lead ship's first deployment. The next TEMP revision must also provide greater detail in Part V, specifically laying out resources to support DT and OT of industry's system design.

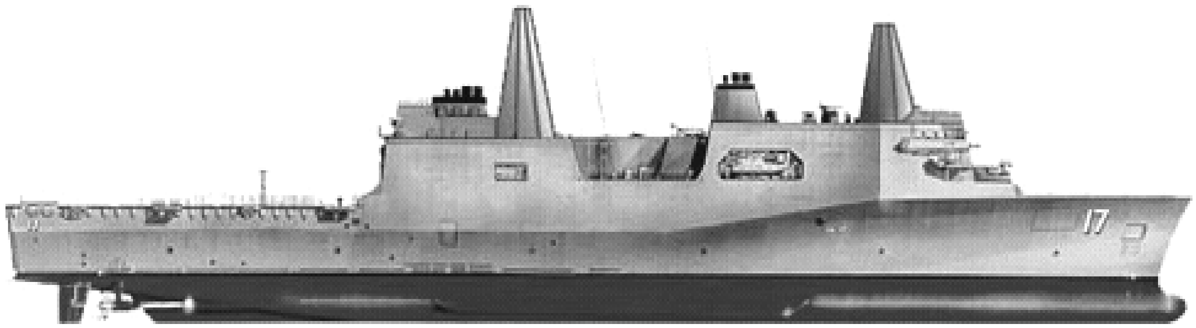
The Navy's LFT&E program for DD 21 is using a combination of surrogate tests, component and system tests, a Shock Trial, a Total Ship Survivability Trial, and modeling and simulation to assess the vulnerability of DD 21 to threats likely to be encountered during combat. The modeling and simulation effort will be calibrated by the results of the various tests, as well as previous combat incidents, to assess the vulnerability of DD 21 in damage scenarios reflecting realistic threat encounters. The Navy will develop a series of Vulnerability Assessment Reports keyed to the various stages of ship design and construction to report the results of their LFT&E effort.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

The Navy and the winning industry team must fully address LFT&E requirements as part of their integrated test program. Additionally, the winning industry team must make a commitment to robust testing of surrogates to address fire spread and develop the ability to extrapolate shock trial results to realistic encounter conditions for underwater explosions. DOT&E is also concerned about the Navy's difficulty in completing the evaluation of testing efforts in a timely manner. The reports for both the CG 19 weapons effects test and the missile booster motor test are many months overdue. Without the test reports, these key testing efforts are not fully contributing to the design of DD 21. The Milestone I Vulnerability Assessment Report discussed in last year's annual report is two years overdue.

The DD 21 Program has established a solid framework for T&E, but a more focused T&E effort must begin in earnest following selection of a Full Service Contractor design in FY01. At that time industry will assume a much larger role in DT&E planning and execution. The next TEMP revision required six months after downselect will be a combined Government and Full Service Contractor development effort. That TEMP revision must provide a clear T&E roadmap and show that the T&E program will produce the data necessary to support an informed Milestone II decision. TEMPs delivered to date have fallen short of that objective. As part of the TEMP revision effort, COMOPTEVFOR requested that the Chief of Naval Operations provide threshold parameters for key DD 21 enabling technologies including the Advanced Gun System, Long-Range Land Attack Projectile, Multi-Function/Volume Search Radar suite, and the Integrated Propulsion System. DOT&E strongly supports the high level of early OT community and user involvement associated with the EOAs that will be conducted in FY02 and FY03. These critically important evaluations will provide early opportunities to identify and correct any significant shortcomings in the DD 21 design, which should reduce the requirement for costly changes during the construction process.

LPD 17 AMPHIBIOUS TRANSPORT DOCK SHIP



Navy ACAT ID Program

Total Number of Systems:	11
Total Program Cost (TY$):	$9.936B
Average Unit Cost (TY$):	$836M
Full-rate production:	3QFY08

Prime Contractor

Litton-Avondale Industries Corp

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The USS San Antonio (LPD 17) class will be diesel-powered amphibious assault ships capable of transiting through the Panama Canal. It will transport and deploy the combat and support elements of Marine Expeditionary Units and Brigades as a key component of amphibious task forces. LPD 17 will be capable of transporting and debarking forces by surface assault craft, including current and Advanced Assault Amphibious Vehicles, air-cushioned landing craft (LCAC), conventional landing craft, as well as helicopters and MV-22s, contributing to ***dominant maneuver, precision engagement***, and ***focused logistics***. A large flight deck will enable the aerial transport of troops and equipment, and a floodable well deck will permit operation of LCAC, conventional landing craft, and amphibious assault vehicles. Storage and offload capabilities will be incorporated for all classes of supplies, including fuel, ammunition, and food for amphibious forces ashore. Ship spaces will be configured for amphibious craft logistic support and limited aviation maintenance and refuel/rearm servicing on the flight deck.

Self-defense capabilities of the LPD 17 will include a Cooperative Engagement Capability (CEC) with other task force vessels, plus the Mk 2 variant of the Ship Self-Defense System (SSDS) (under development), Rolling Airframe Missile (RAM), and the Nulka decoy system to provide own-ship defense against Anti-Ship Cruise Missiles (ASCMs). Two Mk 46 gun systems that are currently being developed separately by the Marine Corps for use on their AAAV will provide defense against surface threats. Installed command, control, communications, computer and intelligence (C4I) systems will interoperate through a modern Ship Wide Area Network (SWAN).

With the exception of the flag capability provided in LPDs, the over-the-side heavy lift capability of the LKAs, and Amphibious Assault Bulk Fuel System and over-the beach/deployment of causeways (current LST capabilities), LPD 17 is being designed to replace several classes of aging amphibious ships, including the LKA, LPD 4, LSD 36, and LST 1179-class ships. Furthermore, with minor exceptions, the LPD 17 will be required to perform the functions of the four classes it will replace, with special emphasis on the capabilities of the LPD 4 Class including the aviation requirements, enhanced communications, and simultaneous or sequential, combined and coordinated, air and surface launched amphibious assaults from over-the-horizon.

BACKGROUND INFORMATION

As the first major ship design program initiated under the revised DoD acquisition regulations, LPD 17 completed a Milestone II review in June 1996. The Commander, Operational Test and Evaluation Force (COMOPTEVFOR) conducted Early Operational Assessments (EOAs) (OT-IA and OT-IB) in FY95 and FY96, respectively. Design deficiencies identified during these EOAs included compatibility with night vision devices, self-defense systems performance, joint planning capability, design and equipment shortfalls in electronic warfare and intelligence facilities, and chemical biological, radiation (CBR) defense capabilities.

OSD approved the Test and Evaluation Master Plan (TEMP) in May 1996. An updated TEMP was approved by OSD in February 2000. The TEMP is currently being revised to describe better the OT-IIB and to address how the ship's self-defense capabilities will be tested and evaluated; this update is expected in February 2001.

The LPD17 Test Team received an award for Outstanding Contributions in Support of Success of Acquisition Reform in the Department of the Navy from ASN RD&A and Department of the Navy Acquisition Reform Office.

TEST & EVALUATION ACTIVITY

A third operational assessment, OT-IIA, began in June 1999 and was completed in November 2000. The OT-IIA was conducted as a series of evaluations of the ship's detail design. The assessment report is in final stages of preparation. Issues identified during those evaluations are reflected below. Like the preceding OT-IB, OT-IIA was performed by a large group of fleet experts in various disciplines associated with amphibious warfare, organized under the leadership of COMOPTEVFOR.

As part of the TEMP approval process, the Navy was required to develop a strategy to evaluate the LPD 17's required Probability of Raid Annihilation (P_{RA}) against Anti-Ship Cruise Missiles (ASCMs). DOT&E participated as a member of the P_{RA} Strategy Senior Leadership Team, providing oversight for the development of the strategy; and will oversee the execution of the strategy. While details for the strategy, including execution, continue to be developed, the technical approach provided by this group appears sound and technically achievable. At this time, funding to execute this strategy has been requested but not received by the service.

The current LFT&E Strategy was approved by OSD in the February 2000 TEMP Update. A waiver from Full-Up, System-Level (FUSL) testing was granted and an alternative LFT&E plan, submitted in lieu of full-up, system-level testing, was approved by OSD in June 1996. The LPD 17 LFT&E program consists of a combination of surrogate tests, component and system tests, a Shock Trial, a Total Ship Survivability Trial, and analyses and modeling. Results of these tests and analyses are being reported in a series of Vulnerability Assessment Reports (VARs) at the end of various stages of ship design and construction. The VAR, based on the Detail Design, is now in early stages of development. The Navy plans to conduct a Full Ship Shock Trial (FSST) on the lead ship in FY05. Subsequent FSST may occur on a follow ship as the objective version of LPD 17 put to sea later in the production cycle. DOT&E has concern about funding for the FSST. PMS 317, the Acquisition Program Manager, requested $25.3 million in additional RDT&E funding in the FY02 POM to cover increased costs estimates for FSST. The request was denied. DOT&E perceives a pattern within the Navy to eliminate funding for FSST. Such action occurred on SSN 21, DDG 51 Flight IIA, and now on LPD 17. The Navy Comptroller restored funding to DDG 51 Flight IIA after DOT&E took action and after the USS COLE terrorist attack. DOT&E believes that the FSST is absolutely essential to understand the vulnerability issues for United States Ships that go into harm's way. The FSST is the only controlled test event against a full ship that approximates a realistic attack.

The overall ship design and construction schedule has been delayed 10 months due to the shipbuilder's lack of readiness to begin construction. This delay will permit missile/mine/torpedo encounter susceptibility studies to provide more credible hit distributions for LFT&E and missile encounter data for P_{RA} analysis, but potentially at the expense of the Detail Design vulnerability assessment effort.

TEST & EVALUATION ASSESSMENT

For the LPD 17, the most significant T&E challenge will be assessing the ship's self-defense capability against ASCMs. Cost, target availability, and safety concerns limit what can be realistically accomplished on the ship. In addition, concerns still remain about the ship's lack of a layered hard-kill system and its capability to detect/track/engage effectively some classes of ASCMs.

Although results from concurrent SSDS Mk 1/RAM tests aboard the Navy's current Self-Defense Test Ship (SDTS) against representative targets have alleviated some prior concerns about RAM performance, this testing exposed previously unknown problems in overall, end-to-end combat system performance. Importantly, major deficiencies with the SSDS Mk 1 combat system were not uncovered until testing aboard the SDTS against realistic targets/engagement geometries. We expect that this will also be the case with the LPD 17's SSDS Mk 2-based combat system. The LPD 17's combat system is fundamentally different from the combat system tested aboard the current SDTS, including different sensors and weapon systems. It has been the integration of these systems that has been both challenging and difficult to test/evaluate without the use of the SDTS. Consequently, the Navy must resource the installation of the LPD 17 combat system aboard an SDTS-comparable platform to validate the modeling, which will evaluate the ship's P_{RA} capability. The SSDS testing on the SDTS will be key to proving out the overall effectiveness of Combat System Performance.

The required test and evaluation for other warfare areas (for example, defense against surface threats) also need to be described in the next TEMP update; the approach is expected to be developed through the T&E-IPT process. While the LPD 17 is equipped with the SLQ-25A NIXIE system for torpedo defense, which is the only system available for use on ships, DOT&E is concerned with the adequacy of this system to provide defense against torpedo attack. Structural enhancements have been incorporated into LPD 17's hull design to improve its resistance to the effects of hull whipping from underwater weapons.

The OT-IIA provided examples of key insights into design deficiencies, which affect operational effectiveness and suitability. Some had been identified in previously conducted EOAs and operational assessments, including compatibility with night vision devices, self-defense systems performance, joint planning capability, design and equipment shortfalls in electronic warfare and intelligence facilities, and chemical biological, radiation (CBR) defense capabilities. The following design deficiencies will affect operational effectiveness and suitability and still need to be resolved:

1. The LPD 17 design still does not fully support night operations because of a lack of NVD-compatible lighting and displays. Areas that are affected include the well deck, flight deck, and some control spaces. The LPD 17 ORD requires the ship to have a capability to conduct aviation Night Vision device operations consistent with the Navy's program. As noted in a message sent from the Commander, Second Fleet to the Chief of Naval Operations, the fleet is currently back fitting existing amphibious ships with NVD modifications; new amphibious ships should be NVD-compatible when acquired. The Operational Commanders have since forwarded a Mission Needs Statement (MNS) to OPNAV for approval.

2. Despite growing concerns about vulnerability to weapons of mass destruction, there are no provisions for chemical and biological agent detectors integrated into the ship's information system. In addition, reaching one of the primary decontamination stations requires contaminated personnel to travel within the skin of the ship for a considerable distance (outside the areas protected by the ship's collective protection system), thereby introducing contamination into the ship's passageways. Because of the likely presence of such items as electrical panels and hose reels, completely decontaminating these passageways afterward would be impossible. There appears to be no provisions for decontaminating aircraft, landing craft, and landing force equipment in the well deck or on the flight deck. Finally, there are critical omissions in the ship's CBR requirements. A tenet of chemical and biological warfare defense is to avoid contamination. This requires standoff detectors, but none are required in the Operational Requirement Document (ORD).

3. The LPD 17 has been designed to carry a substantial amount of cargo; however, there are no installed backup systems for the elevators that service two of the ship's three cargo and ammunition magazines (CAMs). CAMs #1 and #2 combined hold approximately 85 percent of the supplies carried aboard the ship. While neither the ORD nor OP-04 require a back-up elevator system, concern exists that CAM elevator systems should have a redundant capability. A failure to the single elevator that services CAM #1 and CAM #2 would make it impossible to unload ammunition and supplies from the CAMs. If the elevators fail in the middle of an amphibious assault, it might prove impossible to supply the landing force. This is particularly worrisome given the Marine Corps' intention to move to an approach called *Sea-Based Logistics*, in which stocks of ammunition and supplies are kept aboard ship and are brought ashore only when needed, instead of stockpiled ashore.

4. Interoperability with Navy and Marine Corps systems is essential and it is clear that the ship designers have given this area considerable attention. The OT-IIA identified some deficiencies, nonetheless.

    - Although the ship is required to support organizational-level maintenance for the MV-22, it might not be possible to replace a MV-22 engine. The only accessible hoist is in the hangar and the only way to put the MV-22 in the hangar is to stow the wings. Subsequent investigation revealed that manufacturer publications indicate that it may be possible for the MV-22 engine to be removed with the wings in a partially spread mode. This issue needs to be resolved.

    - There is uncertainty about the effect of MV-22's rotor wash on adjacent aircraft and personnel operating on or near the LPD 17's flight deck. Analyses continue to determine effects of downwash velocity profiles on ground personnel.

- As currently configured, the ship is unable to receive real-time information from theater/fleet or Navy/Marine Corps Unmanned Aerial Vehicles (UAV). Although not currently specified in the ORD as a requirement, the OT-IIA assessment team concluded that this capability was necessary. Likewise, the ship must be designed to launch, control, and recover Navy/Marine Corps tactical UAVs. The LPD 17 program has performed two R&D studies for the integration of an UAV system aboard LPD 17. At this time, installation of this capability is funded for the out-year ships, but is not completely funded for the entire class.

5. The ship's radio communication system design does not support the Enhanced Position Location Reporting System (EPLRS) Internet Protocol (IP) data connectivity for landing force C4I nor does the ship's C4I baseline include landing force C4I systems, which had been planned. However, the Digital Wideband Transmission System (DWTS), which is in the current LPD 17 design, can support tactical radio IP data connectivity with the forces established ashore. EPLRS data connectivity capability is scheduled to be included in LPD 17's Digital Modular Radio (DMR) by FY03. Although this will provide support of a force moving from ship-to-shore, additional work is required for other tactical communications links, such as UHF SATCOM. Furthermore, as currently designed, the ship's SIGINT configuration provides no capability to support collection and analysis and indications and warnings for force protection.

Detail Design has fallen behind schedule causing delay in vulnerability assessment work. Development of LFT&E modeling and simulation tools is late and the approach for the VV&A of models has not been defined. However, the Navy's approach for preparation of the Detail Design VAR provides confidence that this VAR will meet LFT&E objectives.

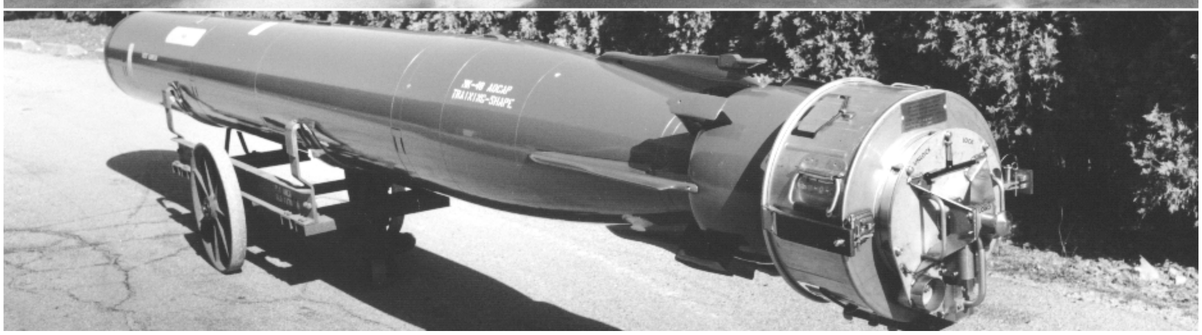
CONCLUSIONS AND LESSONS LEARNED

The series of Operational Assessments have been a valuable tool in validating the design approach in a number of key operational and mission related areas. The feedback provided by the assessment teams, which were largely comprised of operational users from the Navy and Marine Corps, resulted in enhancements to the ship prior to formal operational testing. Examples of these improvements included: addition of a portside JP-5 refueling capability, replacement of the 6K forklift with a 10K forklift, enhancements to C4I capability, expanded access to a cargo elevator, and improved crew messing facilities. Issues that the Navy has not addressed include: compatibility with night vision devices, self-defense systems performance, joint planning capability, design and equipment shortfalls in electronic warfare and intelligence facilities, and chemical biological, radiation (CBR) defense capabilities.

Prime T&E concern at this time is the assessment of P_{RA} and the development of a strategy that includes the acquisition and use of a suitable SDTS to aid in the validation of the models. The technical approach for this effort has been completed, but the strategy to integrate these findings into a comprehensive end-to-end air defense combat systems plan is still under development. The program office must schedule a phase of OT&E with the LPD 17 combat suite on the SDTS to collect validation data for the P_{RA} assessment approach. Furthermore, the Navy has recently initiated an effort to develop a service-wide P_{RA} capability.

The Milestone II vulnerability assessment revealed vulnerabilities in vital ship systems (e.g., the zonal electrical distribution system), and needs for improved troop evacuation procedures and well deck firefighting procedures. The Navy is taking corrective actions in these areas that will be evaluated further in the Detail Design vulnerability assessment. Based on lessons learned from LPD 17 LFT&E efforts to date, the Navy is promulgating firefighting lessons learned to the Fleet after review and approval by the Naval Sea Systems Command.

MK 48 ADCAP TORPEDO UPGRADES



Navy ACAT III Program

Total Number of Systems:	MK 48 Mod 5: 1,087
	MK 48 Mod 6: 403
Total Program Cost (TY$):	Through FY99: $261M
	Through FY00: $314M
Average Unit Cost (TY$):	$51K
Full-rate production:	Block III: 4QFY97
	Block IV: 2QFY01
	COT-DV: Under Review
	CBASS: 3QFY06

Prime Contractor

Northrop Grumman & Raytheon Electronic Systems

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The MK 48 ADCAP torpedo is a submarine launched, heavyweight acoustic homing torpedo with sophisticated sonar and an influence fuzed warhead. The improved ADCAP torpedo includes all digital guidance and control systems, digital fusing systems, and propulsion improvements, which add speed, depth, and range capability. The Mk 48 class torpedoes are the Navy's only submarine launched torpedoes used for engagement of submarine and surface targets, contributing significantly to the submarines' ***precision engagement.*** They are also essential to the ***force protection*** role of submarines. There are a number of upgrades to the ADCAP torpedo discussed in the following paragraphs.

There are two hardware modifications to the baseline ADCAP (MK 48 Mod 5), called the G&C (Guidance and Control) MOD and the TPU (Torpedo Propulsion Upgrade) MOD. The G&C MOD replaces the obsolete guidance and control set with current technology, improves the acoustic receiver, adds memory, and improves processor throughput to handle expanded software demands. The TPU MOD improves the torpedo as described in the classified version of this report. Combined these two hardware modifications comprise the MODS ADCAP (MK 48 Mod 6). A follow-on hardware change to the Mod 6 ADCAP, called the Common Torpedo Development Vehicle (COT-DV), had been planned for fleet introduction in FY01, but is now under review, with anticipated introduction no earlier than FY03. COT-DV is a common processor that will use Commercial-off-the-Shelf hardware and require fewer circuit cards than current G&Cs, which may increase its reliability. Its additional processing power may also enable future software enhancements. Another hardware upgrade, Common Broadband Advanced Sonar System (CBASS) is planned for FY06, and its capabilities are described in the classified version of this report.

Three software builds are currently under oversight. Block Upgrade III (BU III) provides near-term improvements to the Mod 5 ADCAP. BU IV, currently under development, is intended to provide mid-term improvements to the Mod 6 ADCAP. The even more sophisticated CBASS software will follow BU IV. All are described in the classified version of this report.

BACKGROUND INFORMATION

The ADCAP torpedo OPEVAL and B-LRIP report were completed in 1988. ADCAP was reported to be operationally effective against certain threats, but not operationally effective against other threats at that time. The system was reported operationally suitable. The Navy subsequently authorized full-rate production, but Congress constrained procurement because of the concerns identified in test reporting. Modifications were implemented by the Navy to improve performance in certain scenarios, upgrade fuzing systems, and improve reliability. These modifications were considered effective. In 1994, a second software upgrade was introduced to improve performance and reliability. DOT&E assessed ADCAP to be operationally effective following this improvement, but some areas remained unsatisfactory. Additional detail, including areas in which DOT&E reached different conclusions than those reached by COMOPTEVFOR are discussed in the classified versions of the FY94 and FY95 Annual Reports.

The Mod 6 ADCAP, intended to address open issues from previous OT&E, was tested in 1995 and reported in the 1996 B-LRIP report. DOT&E assessed Mod 6 ADCAP to be both operationally effective and suitable. Although the reliability was marginally below threshold, DOT&E identified Mod 6 ADCAP as producing a much better total performance against the COEA threat than the baseline Mod 5 ADCAP. Based on modeling and simulation and on torpedo test data, DOT&E also assessed the Mod 6 ADCAP to provide a significant advantage against nuclear submarines using some difficult evasion tactics, although testing was not conducted against submarines employing these specific tactics.

More detail is provided in the classified version of this report.

TEST & EVALUATION ACTIVITY

With the encouragement of DOT&E, the PMS-404 Program Office has taken a lead in a Target-Threat Simulation Validation (TTV) IPT in an effort to provide agreement on the optimal and most realistic threat simulation for both DT and OT for the CBASS. This was the first such target simulation effort by the submarine force, and it was quickly expanded to encompass all undersea warfare testing, including the SEAWOLF and VIRGINIA programs. TTV has already been used to justify funding applications for both the USS Dolphin upgrade and foreign countermeasure acquisition programs.

DOT&E approved Revision 8 to the TEMP in August 2000. This revision accommodates acquisition strategy adjustments caused by the delay in COT-DV and CBASS hardware development.

This fiscal year's Block IV littoral testing program began and concluded with developmental testing in the Cape Cod Operating Areas. In September 1999, the Navy fired 18 Mod 6 ADCAPs to test improvements to the weapon's shallow water tactical software. In August 2000, 12 more weapons were tested at Cape Cod. The Block IV littoral assessment culminated in the October 2000, when 16 Mod 6 ADCAPs were fired at Cape Cod as part of OPEVAL.

The Prospective Commanding Officer (PCO) school again cooperated with the ADCAP program in its run designs to ensure that some of the events would provide useful torpedo DT data. Most of these runs addressed deep water ASW, including the Close-In Search scenario and Anti-Surface Ship Warfare (ASUW). These exercise torpedo firings in various ADCAP configurations added over 100 inputs to the aggregate torpedo database. The April 2000 Atlantic PCO exercise, included a Dutch diesel-electric submarine (SSK), *Zeeleeuw*. The Australian SSKs *Waller and Collins*, members of the new Collins-class, participated in the July 2000 PCO operations in Hawaii.

The Pacific Submarine force conducted two separate deep water tests, in November and July 2000, to support the development of tactics for the close-in scenario.

An explosion in 1995 of the NUWC land-based dynamometer used to laboratory test torpedoes at deep submergence pressures led to a hiatus on deep/fast target testing. A very limited program of actual in-water deep proofing firings with Mod 6 weapons has been conducted in 1999 and 2000.

Four separate service weapons tests were held, three with Mod 5 weapons, and one with the Mod 6 version, to evaluate the warshot torpedo configuration. There also were two exercises in which Mod 4 warshot weapons were fired at decommissioned surface ship hulks.

In FY01, the Navy is planning to continue its robust schedule of ADCAP torpedo exercises. The standard schedule of PCO exercises will be conducted. Additional cooperative exercises with foreign navies are expected in forward-deployed areas, including the Western Pacific Ocean and the Mediterranean Sea. More details are provided in the classified version of this report.

TEST & EVALUATION ASSESSMENT

Testing was conducted in accordance with the TEMP. The classified version of this report provides details concerning current capabilities that remain untested due to resource limitations.

At the insistence of DOT&E, the ADCAP TEMP includes a requirement for shallow water torpedo tracking instrumentation, in order to better understand weapon performance as it homes in on a submarine target. This capability will assist in scoring and provide valuable ground-truth data for all runs, whether hits or misses, in order to support the goal of testing to learn. The Navy is developing a Target Centered Tracking (TCT) system, which utilizes a strap-on acoustic sensor package aboard a submarine to track incoming weapons. TCT will provide close-in accuracy comparable to or better than most instrumented test ranges, but has the advantage of portability, supporting testing at virtually any site. The Navy has committed to fully funding TCT, with the first unit due in time for CBASS testing in FY03.

The results of the PCO exercises continue to provide an important amount of information concerning ADCAP performance. More details are provided in the classified version of this report.

Since safety considerations preclude actual target intercepts during exercise firings, warshot performance must be assessed indirectly. Warshot performance is described in detail in the classified version of this report.

Extensive Block IV testing has provided a good look at how the Mod 6 ADCAP is performing in shallow water. More details are provided in the classified version of this report.

The Weapons Analysis Facility (WAF) underwent major planned upgrades in FY00, including the transition to a new laboratory building and new computer hardware. The Newport-based facility provides hardware-in-the-loop torpedo simulation in support of weapon system development and testing. According to the original schedule, the changes should have enabled the use of the latest environmental and target models as part of the Block IV assessment, but delays prevented the achievement of these goals. NUWC attempted to salvage the effort by performing a limited model validation to demonstrate the resolution of several of the deficiencies that had been identified in the 1997 VV&A process. However, COMOPTEVFOR determined that the validation effort did not meet their requirements, choosing instead to rely on the ample database of in-water runs to support their assessment. This is the third OPEVAL in which the WAF has not been able to contribute to the actual operational T&E process. The facility is a valuable asset for development purposes, and could, if properly utilized, provide critical supplementary data for weapons evaluations. In particular, the WAF could simulate target evasions and intercepts that cannot be tested in water due to safety rules. It also could use measured test data against surrogates to project performance against threat targets in environments of interest. In order to achieve these goals, the sponsor will have to be willing to provide additional funding. To date, the WAF has relied heavily on REP funds, but OSD has recently taken note of the fact that this is not an appropriate use of REP resources.

As mentioned in last year's Annual Report, the Navy test organization at Keyport, WA in July 1999 questioned the weapon's reliability. Concerns were expressed that Mod 6 weapons being delivered to the Fleet might not meet specifications under the most challenging conditions. The continued poor proofing results have prompted recommendations to the Program Office that the Fleet be provided guidance to restrict operating depths. DOT&E agrees with these concerns and recommendations. More details are covered in the classified version of this report.

ADCAP reliability continues to run in cycles. More details are provided in the classified version of this report. DOT&E notes that work force reductions at the weapon's depots, caused by resource shortages, may be threatening the Fleet's ability to process weapons quickly and accurately.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

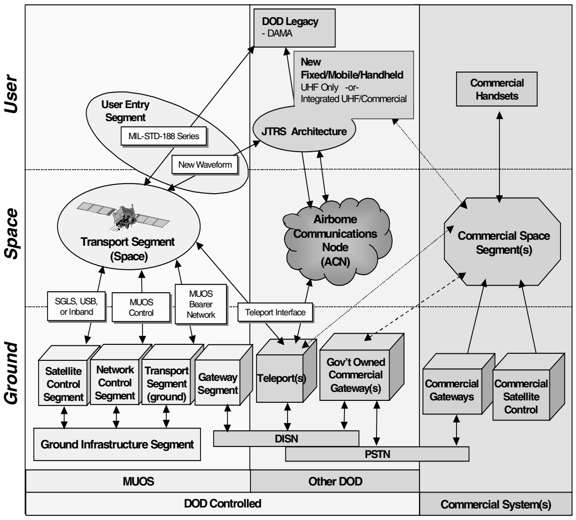
Over the past decade, ADCAP development has produced basic performance levels in both deep and shallow water scenarios, but there is room for further improvement. The Program's plan to address future software changes through a progressive improvements scheme, instead of rigid block upgrades, will allow for a more flexible approach to development. Periodic testing will provide the rigorous evaluations necessary for responsible oversight, and DOT&E supports this scheme. However, there are specific performance limitations, as described in the classified version of this report. DOT&E believes that more competition among available knowledge resources would foster more innovative approaches to solving these problems. DOT&E believes that added emphasis needs to be focused on improving wire performance and reliability. One approach might be the use of fiber-optical guidance wires, as are now used by a number of European torpedoes. Overall torpedo reliability also remains a concern. The reliability problems, whether due to design, manufacturing, or maintenance, must be understood and addressed in order to improve the Fleet's confidence in ADCAP.

As cited in previous reports, some performance questions remain. More details are provided in the classified version of this report. Generally, shallow water testing has generally been done in open ocean without range instrumentation, forcing testers to rely on the tested torpedo's internal monitoring equipment to assess torpedo performance. This can result in post run analysis errors. DOT&E believes that development of an inexpensive mobile, portable test range could prove useful to alleviating some shallow water testing shortfalls. As an interim fix, DOT&E has agreed in the TEMP to shallow water scoring instrumentation, but the Navy does not expect to have such a capability until FY03. The Navy should have provided shallow water scoring instrumentation for FY00 OPEVAL. Additional emphasis should be placed on warshot firings to verify the weapon's ability to hit and sink both surface and subsurface targets.

DOT&E believes that an instrumented shallow water test range would help hasten maturation of littoral anti-diesel submarine tactics and improvement in shallow water ASW torpedoes. The cumbersome nature of open ocean torpedo firings, coupled with seasonal marine mammal habitat restrictions at Cape Cod have significantly lengthened development cycle times. Due to the convenience and availability of deep-water ranges, the Navy still does the significant majority of its torpedo shooting at these sites. Navy and Congressional support for a viable instrumented shallow water test range is strongly recommended.

The Navy's approach of working with foreign diesel submarines, testing ADCAP in actual threat littoral environments, and employing actual off-the-shelf warshot weapons were all positive FY00 initiatives that reflect the Navy's willingness to realistically assess where it stands in littoral undersea warfare, and these initiatives should continue. Inclusion of more challenging tactical and countered scenarios could provide even more benefit.

MOBILE USER OBJECTIVE SYSTEM (MUOS)



Navy ACAT ID Program		**Prime Contractor**
Total Number of Systems:	TBD	TBD
Total Program Cost (TY$):	TBD	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Mobile User Objective System (MUOS) is the key element in the Advanced Narrowband System (ANS), which will provide beyond line of sight (BLOS) connectivity and a ubiquitous presence for Joint military forces to support a variety of Joint Requirements Oversight Council-defined Defense Mission Categories. As the follow-on UHF satellite system supporting a broad range of narrow-band communication equipment, MUOS will allow ***for information superiority*** to tactical forces involved in ***precision engagement***.

The ANS is an evolving strategy that was derived from the Deputy Under Secretary of Defense for Space commissioned Joint Mobile User Study Final Report as a course of action for satisfying the growing unprotected narrowband (64 kbps and below) BLOS communications service requirements. The ANS is composed of six segments: (1) DoD space segment; (2) commercial space segment; (3) Telemetry, Tracking and Command segment; (4) network control segment; (5) user entry segment; and (6) gateway segment. As a sub-set of the ANS, MUOS consists of five segments: (1) Transport; (2) Satellite Control; (3) Network Control; (4) Ground Infrastructure; and (5) Gateway segments.

BACKGROUND INFORMATION

SPAWAR funded six-month concept exploration studies with four contractor teams between November 1999-May 2000. The four teams were Hughes, Lockheed Martin, Spectrum Astro, and Raytheon. On May 18, the Office of the Assistant Secretary of the Navy directed SPAWAR to establish a program office "dedicated to commercial communications evaluation, acquisition, operations, and support." In response to this direction, the acquisition strategy of the MUOS program is presently being re-evaluated in terms of several potential approaches: (1) field or lease a commercial system if the commercial market is sufficiently mature; (2) purchase a government-owned system; or (3) field several "gap filler" satellites to extend the life of the present narrow-band satellite constellation to allow the commercial market to mature sufficiently.

TEST & EVALUATION ACTIVITY

Preparation of the TEMP has been placed on hold until the acquisition strategy is finalized.

TEST & EVALUATION ASESSMENT

None to date.

RECOMMENDATIONS

As the emphasis on commercial approaches increases in this program, so does the importance of a thorough and well-designed OT&E. The test community needs to work together to write and staff a detailed TEMP, which will guide the definition of both developmental and operational testing.

MULTIFUNCTION INFORMATION DISTRIBUTION SYSTEM LOW VOLUME TERMINAL (MIDS-LVT)

Joint ACAT ID Program (Navy Lead)

Total Number of Systems:	2,040
Total Program Cost (TY$):	$2,270.7M
Average Unit Cost (TY$):	$239K
Low Rate Initial Production:	3QFY00
Full-rate production:	3QFY01
OT-IIA-3 Operational Assessment *(F/A-18 MIDS):*	2QFY00
OT-IIB-2 Operational Evaluation *(MIDS on Ships):*	2QFY01
OT-IIA-6/7 Operational Evaluation *(F/A-18 MIDS):*	2QFY03

Prime Contractor

Terminal Design: MIDSCO
Production: ViaSat Data Link Solutions

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Multifunctional Information Distribution System-Low Volume Terminal 1 (MIDS-LVT 1) provides Link 16 digital data communications to host fighter, surface combatant, airborne laser, reconnaissance, and Command and Control (C2) host systems, providing a ***common relevant operational picture*** of theater air and surface activity. Link 16 provides a jam-resistant network for **Joint and Multinational Force** data sharing. The early warning and air track identification information provided by Joint sensor and C2 platforms supports the coordination of long-range ***precision engagement*** fires, safe passage zones, and near real-time warnings of impending attack—contributing to f***ull-dimensional protection***. The surveillance and weapons coordination engagement options provided by Link 16 enable ***synchronized operations*** and employment of the ***correct weapons*** for each target to generate the desired results. Engagement intentions and results are shared by all network participants, contributing to improved ***decision making*** by the Battle Commanders. The MIDS-LVT 1 terminal shares a number of components with the Army MIDS-LVT 2 and USAF F-15 Fighter Data Link terminals, providing a significantly improved level of ***sustainment interoperability***.

MIDS includes the MIDS-LVT terminal, power supply, and host platform software, antenna, and displays. The MIDS-LVT contains Shop-Replaceable Units (SRUs) that can be replaced or removed depending on host needs. For surface ship applications, the 200-watt MIDS-LVT Power Amplifier is augmented with a 1,000-watt High Power Amplifier. For fighters, the MIDS-LVT contains a Tactical Air Navigation (TACAN) SRU.

Planned MIDS-LVT 1 host platforms include AEGIS destroyers, next-generation aircraft carriers, amphibious ships, F/A-18 fighter aircraft, F-16 fighters, Airborne Laser, and NATO systems.

BACKGROUND INFORMATION

The MIDS-LVT terminal was developed by an international consortium coordinated through MIDSCO. MIDSCO was dissolved in June 2000, and will not participate in the production phase of MIDS-LVT.

In April 2000, the DAB approved the Lot 1 LRIP of MIDS-LVT terminals. The LRIP production vendors are ViaSat and Data Link Solutions. The LRIP terminals will be used for host platform integration, testing, and early fielding. Approval of a second LRIP lot is anticipated in FY01.

The test strategy is based on the evaluation of the MIDS-LVT terminal, as integrated into the host platform; since, by itself, the MIDS terminal provides no combat capability. Experience from test and evaluation of the predecessor Joint Tactical Information Distribution System Class 2 terminals suggests that integration of the terminal into the host is a critical technical challenge. Integration efforts underway include: F/A-18 C/D/E/F variants, F-16C Blocks 40 and 50, Navy Surface Force, Army PATRIOT, and the Airborne Laser program.

TEST & EVALUATION ACTIVITY

MIDS-LVT testing for FY00 included both DT and OT events. The Capstone MIDS-LVT TEMP, the F/A-18 Integration Annex, and the Shipboard Annex supported the testing. The program's TEMP status is as follows:

- The Joint TEMP addressing Link 16 interoperability testing has been approved.
- Updates to the Navy MIDS-LVT TEMP Annex and F/A-18 MIDS TEMP Appendix have been reviewed by DOT&E.
- The TEMP Appendix for MIDS on Ship and a draft F-16 MIDS Integration TEMP Annex were provided for DOT&E review.

The OT-IIA-2 Test Plan, which supported operational testing for F/A-18 integration, was approved by DOT&E.

An exhaustive F/A-18 integration DT consisted of laboratory Hardware-in-the-Loop laboratory testing as well as flight testing phases.

Three EMD MIDS-LVT equipped F/A-18C/D fighters participated in the All Service Combat Identification Evaluation Team (ASCIET) 2000 event. While not a pre-planned DT event, two aircraft flew twice daily conducting Combat Air Patrol (CAP) missions against adversary aircraft. CAP stations alternated between overwater and overland airspace under the control of various C2 platforms. The F/A-18s flew 43 sorties participating in the ASCIET Joint Service Link 16 network. The network included USAF E-3 AWACS, E-8 JSTARS, and RC-135 Rivet Joint; USMC Tactical Air Operations Center; Army JLENS, PATRIOT and FAAD C2; Navy E-2C, DDG, F-14D, and F/A-18; United Kingdom Tornado FR1 and Frigate as network participants in an operationally stressing environment.

Commander, Operational Test and Evaluation Force (COTF) and VX-9 test pilots conducted one operational test, OT-IIA-2, during ASCIET 2000. Four OA sorties flew profiles identical to the DT events.

The MIDS on Ship program conducted DT-IIB 1 as a laboratory test event employing MIDS on Ship hardware and software interfacing with representative Navy Link 16 host platforms such as the E-2C, F-14D, and other surface ships.

TEST & EVALUATION ASSESSMENT

Results of DT laboratory tests and participation in ASCIET indicated that MIDS-LVT, as currently integrated into the F/A-18, provided a basic level of Link 16 digital data interoperability with Joint and Allied Link 16 capable platforms and contributed to the completion of the F/A-18 mission. Entering the Link 16 network on every flight, the F/A-18s exchanged position, track, and targeting coordination messages among themselves and other network participants. The F/A-18s reported their air tracks to network participants and received command messages from AWACS via Link 16. The aircrew stated that, when working, MIDS provided improved situational awareness of threats and friendly forces, including intentions.

OT-IIA 2 testing conducted during ASCIET identified a number of F/A-18 MIDS-LVT compatibility and training shortfall issues. First, MIDS-LVT integration frequently caused the F/A-18 mission computer to stop processing data. This required an in-flight computer reboot. Second, the terminal suffered numerous Interference Protection Feature (IPF) alerts, indicating possible out-of-band transmissions of Link 16 data. The indication of an IPF to the aircrew was not apparent. The aircrew relied on other network participants to inform them that they were not transmitting. The current IPF alert, located a number of layers beneath the in-flight tactical display, is not visible and therefore does not properly alert the aircrew. It is essential that this alert be moved to the display page most viewed or, by placing an alert in the Heads-Up Display and providing an audible alert. Once the aircrew was alerted, the IPF re-set function proved unreliable. Third, as indicated by performance problems discovered during DT, the MIDS-LVT TACAN still exhibited deficiencies in both air-to-air and air-to-ground modes. Lastly, Digital Link 16 voice communications were attempted; however, MIDS was unable to satisfactorily exchange voice communications.

The COTF OT-IIA 2 evaluation conducted during ASCIET concluded that MIDS-LVT integration in the F/A-18 was potentially not operationally suitable. This evaluation was based on the problems experienced by the aircrew during OA missions and as enumerated above. In addition, the OA indicated that the throttle grip five-position switch modification and the display symbol overloads experienced were not operationally acceptable. Since the scope of the evaluation was limited by the Navy to two areas—compatibility and human factors—the OA did not collect data or comment on the potential operational effectiveness of MIDS-LVT integration into the F/A-18.

The DAB, as exit criteria for the next acquisition phase, LRIP Lot 2, directed that OT-IIA 3 deficiencies be corrected and a satisfactory OT-IIA 3 OA report be submitted.

CONCLUSIONS AND RECOMMENDATIONS

In summary, OT-IIA 2 indicated that integration of MIDS into the F/A-18 is immature. Discrepancies included:

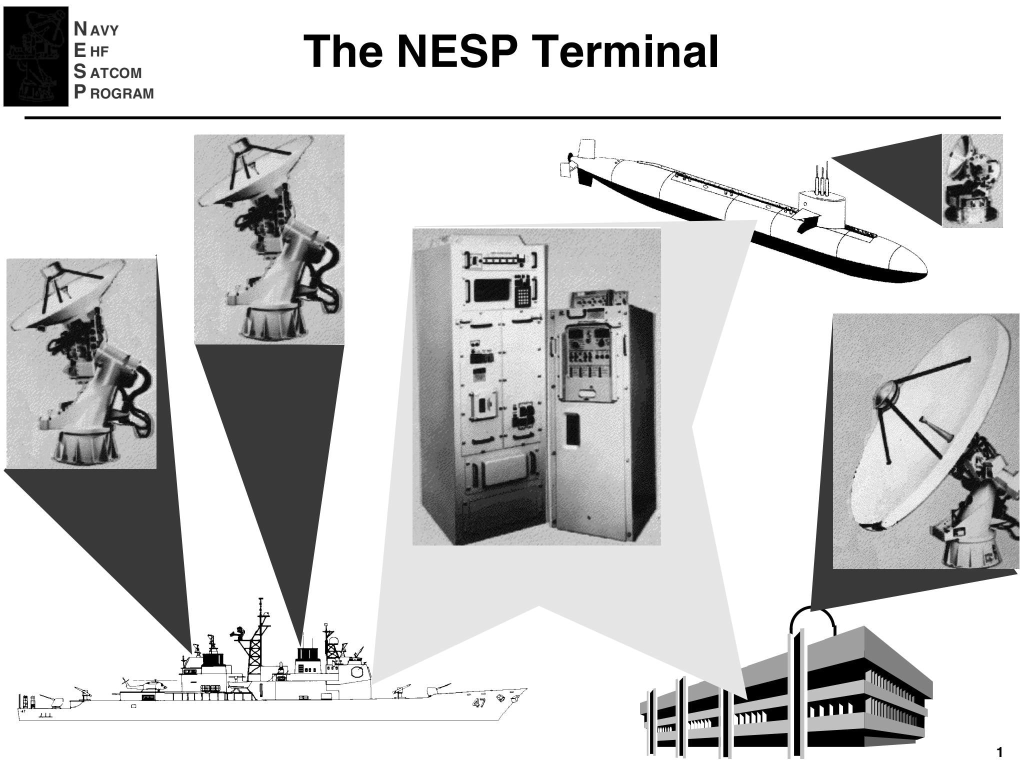
- Mission Computer failures during MIDS operations.
- MIDS Tactical Air Navigation not supporting the operational requirement.
- The aircrew MIDS displays were frequently overloaded (by symbology).
- The aircrew throttle grip provided improper cues to aircrew.
- There were many Interference Protection Feature alerts; these alerts were not readily visible to the aircrew while in flight; and the IPF re-set feature was intermittent.
- F/A-18 MIDS entry into the Link 16 network included unwieldy workarounds and inaccurate information.

The discovery of these discrepancies and their operational impact were brought about by participation in scheduled operational exercises. Leveraging exercises such as ASCIET provides early operational insight into MIDS development and integration. To gain the utmost knowledge however, improvements in collecting and sharing DT data are needed. Additionally, test schedules should provide adequate time between events to analyze test data to improve learning and the product.

The OT-IIA 2/ASCIET event provided the developer, user, and operational tester with the first operationally relevant experience with MIDS-LVT integration into a host platform. While some of the problems discussed above had been observed in laboratory testing, the magnitude and impact were not realized until the system was placed in this robust operational environment. In particular, many of the mission computer failure modes were seen in the lab testing, but the frequency with which they occurred and the impact upon mission was not anticipated.

In order to derive meaningful results from leveraged test events, comprehensive planning must take place between the test organizations. Results of the event may be complicated by the separation of test responsibilities and data collection and analysis among testers. In order to derive maximum benefit from the test, each group must have insight into the overall picture. Sharing of DT data and results among the MIDS developer, F/A-18 platform DT agencies, the user, COTF, and DOT&E must continue to be stressed and every opportunity to improve must be utilized.

NAVY EXTREMELY HIGH FREQUENCY SATELLITE COMMUNICATIONS PROGRAM (NESP)



Navy ACAT IC Program

Total Number of Systems:	359
Total Program Cost (TY$):	$2.1B
Average Unit Cost (TY$):	$5.8M
Full-rate production:	3QFY93
Production Decision for Follow-On Terminal:	1QFY06

Prime Contractor
Raytheon

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Navy Extremely High Frequency (EHF) Satellite Communications Program (NESP) terminal connects ship, shore, and submarine platforms to the Military Strategic and Tactical Relay (MILSTAR) satellite constellation. The NESP terminal supports survivable, endurable, and flexible worldwide command and control communications to strategic and tactical Naval forces through all levels of conflict. The NESP terminal provides minimum essential secure communications in stressed environments that require anti-jam and low probability-of-intercept capabilities. NESP will enable our forces to maintain ***information superiority*** through all levels of conflict, enhancing ***full-dimensional protection*** to our warfighters by capitalizing on the unique capabilities of the MILSTAR satellite system.

There are three different configurations of the NESP terminal corresponding to ship, shore, and submarine platforms. Although each terminal has the same basic capabilities, their antennas and other peripheral equipment vary by platform. In addition to communicating with the MILSTAR satellites, the NESP terminals can operate with the EHF Package on Fleet Satellites 7 and 8 and with EHF packages on UHF Follow-On satellites 4 through 10.

In keeping with the 1992 restructuring of the MILSTAR program, the NESP terminal is being upgraded to add a tactical medium data rate (MDR) capability to the existing strategic low data rate (LDR) capability. The maximum low data rate is 2.4 kbps, while the maximum medium data rate is substantially higher at 1.544 mbps. A limited number (71) of the existing NESP ship and shore terminals are being upgraded with a medium data rate appliqué to achieve the combined low/medium data rate MILSTAR capability. However, to satisfy terminal requirements beyond upgrading the existing NESP ship and shore terminals, the Navy has initiated a new Follow-On Terminal program. In addition to providing low/medium data rate communications at extremely high frequencies, the Follow-On Terminal will also support super high frequency satellite communications and Global Broadcast Service satellites. The submarine low data rate terminals are undergoing medium data rate upgrades, including modification for a new mast and 16" antenna, as well as addition of the super high frequency and Global Broadcast Service capabilities.

The Navy is developing two new communications controllers, the Navy EHF Communications Controller (NECC) and the Time Division Multiple Access Interface Processor (TIP). The NECC and TIP are baseband interface units that allow more efficient use of MILSTAR satellite resources. The NECC supports LDR networks, while the TIP supports MDR networks.

BACKGROUND INFORMATION

The NESP low data rate terminal reached full production status in 1993. IOT&E for the low data rate terminal included three operational tests:

- The first operational test, OT-IIA in June 1988, supported the Milestone IIIA decision in September 1988.

- The second and third operational tests, OT-IIB and OT-IIC (conducted in September 1990 and August 1992, respectively), supported the Milestone IIIB decision in April 1993.

  Since the NESP IOT&E occurred before the first MILSTAR satellite was on orbit, Navy Fleet Satellites with EHF payloads supported the three IOT&E events. Two follow-on operational tests were conducted after the first MILSTAR satellite was in orbit.

- OT-IIIA (August and September 1994) and OT-IIIB (June, July, and September 1996) verified the NESP terminal with an in-orbit MILSTAR satellite. OT-IIIA addressed unresolved issues and deficiencies observed in prior tests, while OT-IIIB addressed low data rate anti-jam and low probability of intercept performance.

TEST & EVALUATION ACTIVITY

Army, Navy, and Air Force terminals participated in the developmental MILSTAR System Tests in July 1997, August 1998, and August 1999. In these medium data rate-focused developmental tests, Service terminals were connected to the MILSTAR satellite payloads at the contractor's facility in Sunnyvale, CA. The Army's low/medium data rate capable Secure, Mobile, Anti-jam, Reliable, Tactical Terminal (SMART-T) and the NESP terminal, equipped with a medium data rate appliqué, participated in both low and medium data rate tests. The Air Force Command Post Terminal and the Army Single Channel, Anti-Jam, Man-Portable (SCAMP) terminal participated in the low data rate tests. These tests examined the compatibility and interoperability of the NESP terminal with both MILSTAR payloads. The tests included low and medium data rate signal acquisitions, simultaneous network operations, interoperable network and point-to-point calls, antenna and network control functions, and Year 2000 rollovers.

The April 30, 1999, MILSTAR Flight 3 launch failure has delayed the planned in-orbit testing of the NESP MDR appliqué by approximately one year. Operational testing will now occur following the launch of MILSTAR Flight 4, expected in 2QFY01. After Flight 4 in-orbit payload checkout is complete, NESP MDR terminals will participate in MILSTAR System Test 8000, a technical test to demonstrate compatibility and interoperability with the low and medium data rate payloads in orbit. Tests will include satellite acquisition, simultaneous network operations, interoperable network and point-to-point calls with Army, Navy, and Air Force terminals, and antenna and network control functions.

The medium data rate OT&E for the NESP terminal, which will evaluate the operational performance of the MDR appliqué terminals and the NECC, is being planned for 2QFY01. The test will be conducted using on shore and at sea terminals, and will include Army terminals to demonstrate Service terminal interoperability. Follow-on tests will be conducted to address the TIP, which is still under development, and any other issues that are not fully resolved during this test.

The submarine MDR terminal operational test schedule will be integrated into the overall MILSTAR and NESP terminal test schedules to the greatest extent possible, consistent with submarine terminal progress. Current plans are to conduct submarine terminal testing jointly during operational testing of the NESP ship and shore terminals in 2QFY01. Operational test of the NESP Follow-On Terminals is scheduled to begin 2QFY02.

TEST & EVALUATION ASSESSMENT

At the completion of the low data rate Initial Operational Test and &Evaluation, DOT&E concluded that the ship and shore NESP terminals were operationally effective and suitable. These findings supported full fleet introduction. COMOPTEVFOR and DOT&E recommended follow-on operational test to evaluate the suitability of the submarine terminal and the survivability of the ship and submarine terminals.

OT III-A verified the interoperability of the NESP terminal with a MILSTAR satellite, and completed resolution of all critical operational issues, except survivability, as satisfactory. The survivability issue was resolved as satisfactory in OT III-B, which addressed the anti-jam and low probability of intercept performance of the ship and submarine terminals.

Although the MILSTAR submarine terminal does meet the technical and operational requirements for low probability of intercept, operational tests showed that the submarine had a substantially higher probability of signal intercept than developmental tests had indicated. These low probability of intercept results re-inforce the role of operational testing in providing the warfighter with the most accurate operational performance information possible.

The MILSTAR satellite system provides earth coverage (low data rate) via a system of 37 separate but adjoining downlink communications beams called "agile" beams. Previously, the Navy terminals did not perform beam management techniques required to handle terminals as they transited from one beam coverage area to another. Operational testing confirmed that when the terminal that set up the communications network transitioned to an adjacent antenna beam, the satellite would turn off the "exited" beam and terminate communications service to all terminals remaining in that beam. Beam management techniques have since been incorporated into the terminals and will be operationally tested as part of Flight 4 operational tests.

The failure of MILSTAR Flight 3 has complicated NESP operational test planning and execution. The NESP TEMP and associated test plans are being updated for DOT&E approval in anticipation of testing with the in-orbit MILSTAR satellite in 2QFY01. Although the overall test approach is sound, the Navy will need to take a very aggressive approach to complete test planning, resourcing, and coordination in time to take full advantage of all opportunities for joint-Service terminal testing with an in-orbit satellite.

CONCLUSIONS

NESP LDR terminals are operationally effective and suitable. Although there are no known serious operational deficiencies, determination of NESP MDR operational effectiveness and suitability cannot be made until after completion of MDR OT&E with an in-orbit satellite.

RECOMMENDATIONS

In-orbit testing of the MDR capable NESP terminals has been delayed to 2QFY01 by the launch failure of MILSTAR Flight 3. The Navy will need to continue its aggressive approach in planning, resourcing, and coordinating upcoming tests in order to take full advantage of opportunities to conduct combined DT/OT, Joint Service terminal, and in-orbit satellite tests. Additionally, coordination and approval of an updated TEMP and associated operational test plans must be expedited to avoid test delays.

NAVY STANDARD INTEGRATED PERSONNEL SYSTEM (NSIPS)

Navy ACAT IAM Program		**Prime Contractor**
Total Number of Systems:	1 (850 sites)	Lockheed Martin
Total Program Cost (TY$):	$118M	
Average Unit Cost (TY$):	$139K	
Full-rate production:	3QFY02	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Navy Standard Integrated Personnel System (NSIPS) will consolidate the Navy active and reserve personnel field source data collection systems, both ashore and afloat. The objective is to produce a standard single point of entry system for all personnel and pay information. The primary interfaces for NSIPS will be with systems belonging to the Defense Finance and Accounting Service (DFAS). NSIPS provides pay and personnel functionality for the Naval reserve force in Release 0 and for the Naval active force in Release 1. The client-server architecture will have information held at the local level and at regional data servers, using a corporate-level data base for survey purposes.

NSIPS supports the ***Joint Vision 2020*** paradigm by providing commanders with up-to-date, accessible information on the strength of their forces, hence facilitating the operational concept of ***dominant maneuver***. In addition, ***information superiority*** will support the conduct of dominant maneuver by enabling concurrent planning and coordination of widely dispersed forces.

BACKGROUND INFORMATION

Prior to Milestone II (1QFY98), the program developed a prototype system to prove out the planned architecture and "user friendliness" of the graphical user interface. *PeopleSoft* was selected as the basic human resource software package. The software package was customized and Navy requirements were incorporated. An operational assessment on the prototype was conducted in August and September of 1997. In May 1998, an Acquisition Decision Memorandum (ADM) approved funding for hardware deployment to 64 NSIPS sites.

In December 1998, an ADM authorized additional funding for continued hardware deployment through 1QCY99. Based upon an independent assessment of the software development effort, an ADM was approved in March 1999 granting program authority to expend additional funds to continue hardware deployment through 3QCY99.

The operational test activity, the Navy's Operational Test and Evaluation Force (OPTEVFOR), conducted a DT assist during May 1999. From this evaluation, the Navy found that NSIPS demonstrated the software maturity required in the March 1999 ADM, and concluded the NSIPS program manager should be able to proceed with software development.

TEST & EVALUATION ACTIVITY

The Release 0 operational evaluation began in mid-September 1999. Various deficiencies were noted, such as inadequate hardware and software configurations, inaccurate transmittal logs, missing e-mail functionality, corrupted reports, improperly established security roles, inadequate responses from the help desk, memory leaks, inadequate connectivity, and inadequate training.

The NSIPS program manager developed a plan of action to address the system shortcomings, and beginning in October 1999, three separate software builds were installed to address the noted deficiencies. The program manager proposed a new schedule for continuing the operational evaluation. End-to-end testing with DJMS-RC was conducted in early November 1999. The operational evaluation resumed later in November 1999.

In January 2000, OPTEVFOR briefed its Release 0 final operational evaluation report to the DOT&E Action Officer and representatives from the Office of the Assistant Secretary of Defense (C^3I) and the developmental test community. COMOPTEVFOR determined Release 0 was operationally effective and operationally suitable, and recommended approval for fleet introduction. COMOPTEVFOR also described two minor deficiencies identified during the operational evaluation, related to reliability and interoperability, and recommended fixes to the deficiencies.

TEST & EVALUATION ASSESSMENT

The OSD Action Officer chaired a review in January 2000 to assess the readiness of NSIPS Release 0 to deploy to the Naval reserve force. It was determined that Release 0 was operationally effective and operationally suitable; the IPT recommended that the milestone decision authority approve fielding of Release 0, provided an approved Acquisition Program Baseline and certification of system interoperability are made available. Release 0 is currently operational at 260 reserve sites, and replaced the Reserve Standard Training, Administration, and Readiness Support (Manpower and Personnel) System.

In June 2000, the NSIPS program office announced a deviation in the Acquisition Program Baseline because of a four-month schedule slip in software development, and proposed correcting its schedule breach by splitting Release 1 into two increments. The first increment would address functions associated with personnel actions for the Naval active force and would undergo a full operational evaluation. Upon demonstration of operational effectiveness and suitability, the increment would be deployed. The second increment would address functions associated with pay actions for the Naval active force and undergo a full operational evaluation.

A Flag-level suggestion was raised during a briefing in mid-November 2000 to consider stopping the development of Release 1 after the completion of the first planned increment—fielding DMO rather than the second planned increment of Release 1 to address pay functionality for the Naval active force. The underlying reasons to explore this option included the slip of initial operational capability to April 2002 and the ability of the DMO module to allow early replacement of UMIDS. The DMO module is similar to UMIDS, but is a user-friendly Windows-based application. An action was taken to explore options, costs, benefits, risks, and the impact on schedule and the Operational Requirements Document before the next Flag brief.

Working group members met in early December 2000 to review the functionality of the second increment of NSIPS Release 1 and the DMO module. The working group unanimously recommended replacing UMIDS with DMO as an interim solution until the second increment of Release 1 of NSIPS is delivered. Also in early December, the Requirements Integrated Product Team reviewed options in response to the Flag brief action item. The overall recommendation was to continue development of NSIPS Release 1 while continuing to explore the feasibility of deploying the DMO module to replace UMIDS on an interim basis.

Several actions are pending before the potential fielding of the DMO module can be fully evaluated. These actions include confirming the technical feasibility of the DMO module, completing the surveys and tests on hardware available to field the DMO module, determining the total cost of the DMO deployment on ship and ashore, determining the best strategy to deploy DMO based on the Release 1 schedule, and identifying the funding source.

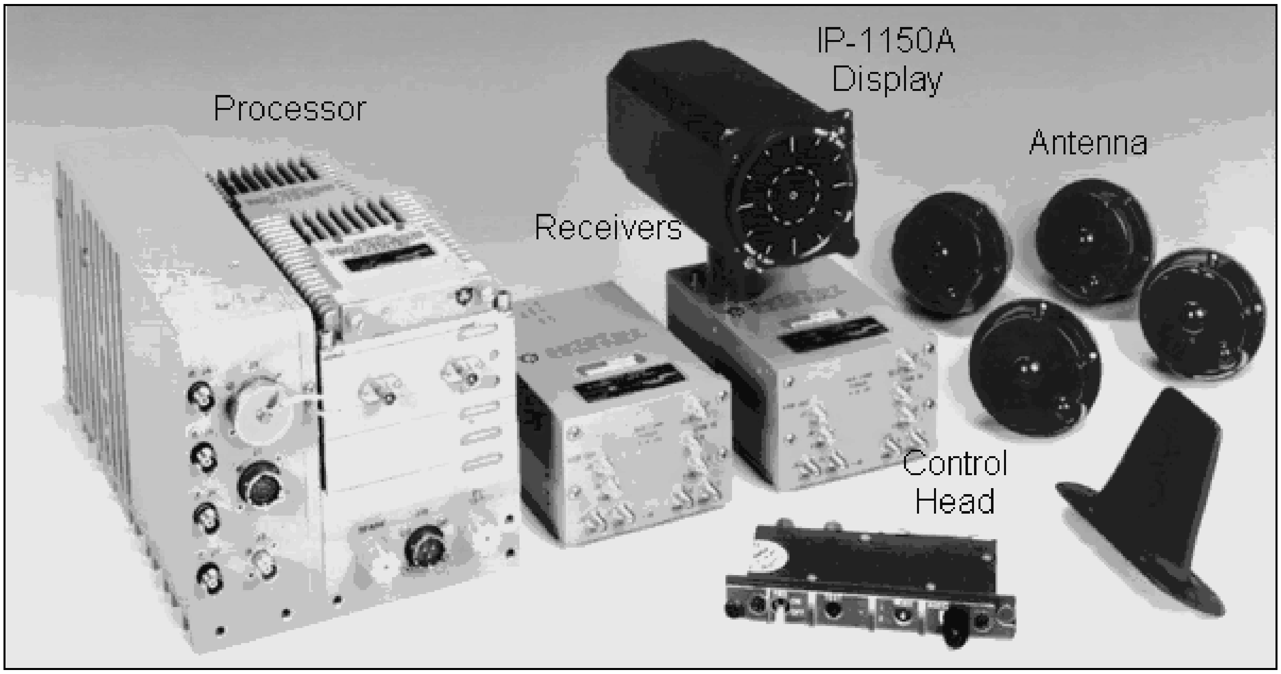
During the Flag brief in mid-December 2000, the NSIPS program office presented the current test status. Operational evaluation is scheduled for March 2001, with the Milestone decision expected in July 2001. Setting aside the DMO module potential, operational evaluation of the second increment of Release 1 is scheduled for February 2002, with the Milestone decision expected in April 2002. Full operational capability is planned for July 2002. The NSIPS program office concluded that continuing to evaluate the feasibility of deploying DMO to replace UMIDS on an interim basis is a good risk-mitigation strategy.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

NSIPS continues to be under development with in-house unit testing taking place concurrently. Robust developmental testing is crucial to ensure that operational testing truly tests the ability of NSIPS to support the pay and personnel functions of the Naval Reserve and Active forces. DOT&E has consistently worked hand-in-hand with the NSIPS program office to ensure sufficiently robust developmental testing. DOT&E has encouraged the NSIPS program office to learn from the test experiences of the Release 0 product. To conduct an adequate operational test of NSIPS, DOT&E has recommended that legacy system performance data be collected at the test sites to allow a baseline comparison. In addition, it is imperative that OPTEVFOR clearly defines the test objectives for Release 1; this will allow better data collection and evaluation on behalf of DFAS interests.

DOT&E has provided significant contributions in helping to shape the NSIPS incremental evaluation strategy for Release 1. These contributions have been well received by the NSIPS program office. On behalf of the oversight test community, DOT&E has offered much-needed guidance regarding the need to bring to test a Release 1 product that will meet the needs of NSIPS users.

RADAR WARNING RECEIVER (RWR) AN/APR-39A (V)2



Navy ACAT IIIC Program		**Prime Contractor**
Total Number of Systems:	700	Litton Advanced Systems Division
Total Program Cost (TY$):	$234M	
Average Unit Cost (TY$):	$150K	
Full-rate production:	3QFY96	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The AN/APR-39A (V)2 Radar Warning Receiver (RWR) contributes to the ***Joint Vision 2020*** concept of ***full-dimensional protection*** by improving individual aircraft probability of survival through improved aircrew situational awareness of the electromagnetic threat environment. The AN/APR-39A (V)2 is a multi-Service (Navy/USMC, and Special Operations Force) next generation RWR upgrade to the existing AN/APR-39 (V1). The upgraded system is intended for helicopters and other non-high performance aircraft. It is capable of detecting and providing alerts to the aircrew of SAM and antiaircraft artillery associated pulse, pulse Doppler, and continuous wave radar activities identified from a software programmable threat library. In addition to the cockpit video display, the APR-39A (V)2 provides the aircrew with synthetic speech audio threat warnings, facilitating a "hands on/heads up" aircrew posture. The system also integrates the Aircraft Survivability Equipment Suite, and provides a single controller for power and Built-In Test, as well as a single display for threat information. The system can integrate and display data from an on-board missile warning system, laser warning system, and expendable countermeasures dispenser. The system retains the former AN/APR-39A (V)1 low band vertically polarized blade antenna. The new, more sensitive, circularly polarized spiral antennas are a form and fit replacement for the previous equipment, as is the new night vision compatible cockpit video display and the cockpit control unit. An assessment of integrated system effectiveness and suitability of upgrades will be evaluated during host platform Follow-on Operational Test and Evaluation (FOT&E).

BACKGROUND INFORMATION

Early Navy OT in the USMC AH-1W helicopter, from 1QFY91-2QFY92, found the system not operationally effective and potentially operationally suitable. Fleet introduction was not recommended until a subsequent OPEVAL could demonstrate satisfactory resolution of OT-IIA deficiencies.

OT-IIB in a USMC UH-1N helicopter (in accordance with a DOT&E-approved TEMP and test plan) was completed by COMOPTEVFOR in May 1995, with a finding of operationally effective and suitable and a recommendation for fleet introduction into UH-1N. Involvement by the Operational Test community in the DT leading to this phase of OT facilitated meaningful use of DT test results and allowed some streamlining of OT-IIB. DOT&E staff and support analysts observed major portions of OT-IIB testing and data collection.

Since the AN/APR-39A (V)2 RWR is not a major defense acquisition program, no B-LRIP report was produced. The system is covered by language in the National Defense Authorization Act for Fiscal Year 1989, Conference Report (H.R. 4481, page 345) which "directed that all future operational test results for RWR update programs be reviewed and approved by the Director of Operational Test & Evaluation, prior to obligation of production funds."

The Navy Milestone III was approved in 1QFY96. AN/APR –39A (V)2 systems are intended as the standard RWR for the UH-1N, AH-1, V-22, VH-60, HH-60, SH-60, CH-53, MH-53, KC-130, and the VH-3 aircraft. Follow-on Operational Test and Evaluations of selected host platform integration efforts are planned for FY01.

TEST & EVALUATION ACTIVITY

Several contractor and government developmental tests aimed at evaluating the APR-39A(V)2 system performance occurred throughout FY99 and FY00. Litton has completed contractor first article testing, verification of basic operating software functionality and interface testing on the upgraded hardware and software. Successful Line Replaceable Unit-level tests have enabled the program to proceed into system-level testing at both the contractor and government facilities. AH-1W, HH-60, CH-53E, and MV-22 host platforms are scheduled to perform FOT&E of integrated APR-39A(V)2 systems in FY01.

The first production units marked for testing were delivered in 3QFY99 and installed on AH-1W, the lead FOT&E platform. The AH-1W APR-39A(V)2 Electronic Warfare suite and associated operating software were delivered to the government for independent validation and verification testing as part of host platform integration test efforts. Developmental flight testing on AH-1W started in July 1999 at the Rotary Wing Test Directorate at Naval Air Station Patuxent River, MD. Developmental testing has been completed and an independent FOT&E period on AH-1W is scheduled to start in November 2000 upon issuance of readiness certification by the developing activity. HH-60 FOT&E is also scheduled for completion in November 2000. HH-60 has undergone platform unique validation and verification testing as part of their developmental test programs.

The APR-39A(V)2, as integrated on the MV-22, was delivered to the government as Contractor Furnished Equipment. The Electronic Warfare suite, as installed and integrated, was tested as part of the MV-22 complete airframe IOT&E in July 2000. Data from these tests are currently being evaluated and the results of that evaluation will be reported in the MV-22 BLRIP Report due 1QFY01. Plans to conduct FOT&E of the APR-39A(V)2 in the HH-53 and KC-130 are now uncertain due to funding shortfalls.

The AN/APR-39A TEMP Update was approved by OSD 15 August 2000. The AH-1 and HH-60 Follow-on Operational Test Plans were approved by DOT&E on 3 October 2000 and 30 October 200 respectively.

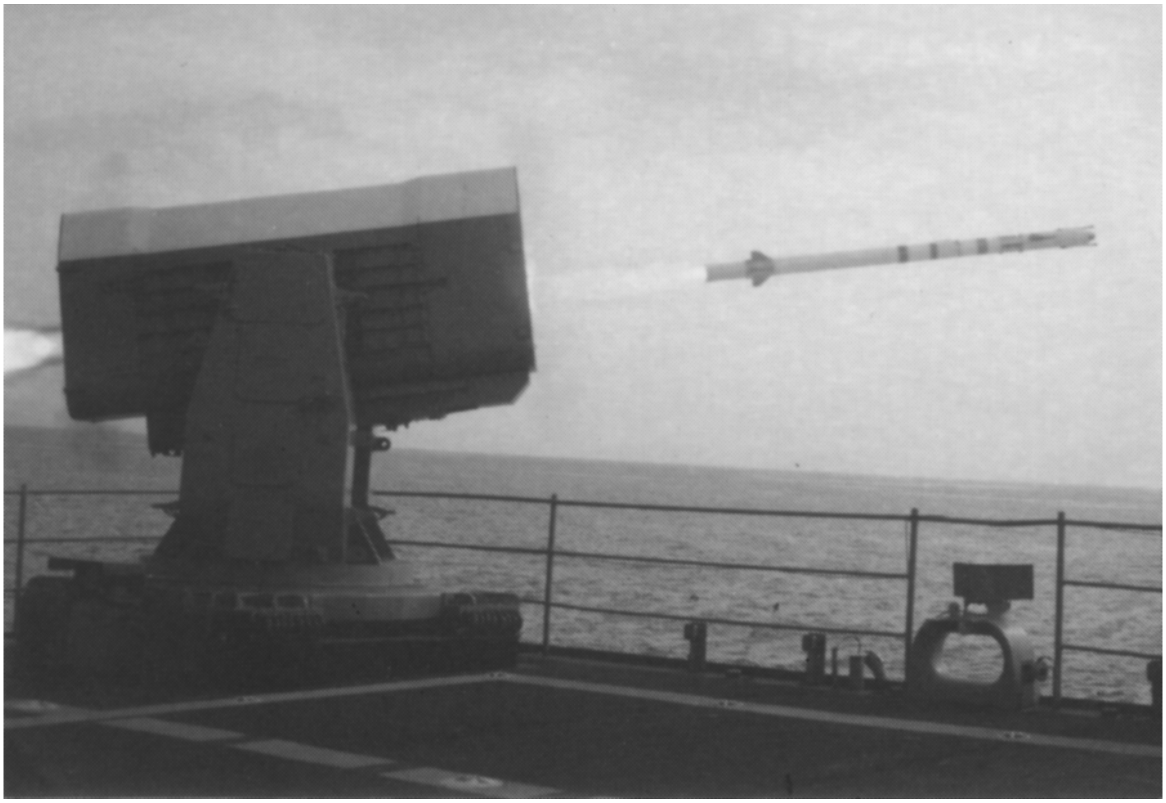
TEST & EVALUATION ASSESSMENT

The APR-39A(V)2 is undergoing a multi-platform test and evaluation program, which encompasses several platforms undergoing unique phases of their acquisition life cycle. Contractor qualification testing and government independent validation and verification testing have proceeded relatively well considering the complexity and integration challenges of these systems. Management of diverse platform mission and integration requirements has gone well. Issues involving the Test and Evaluation Master Plan have been resolved, and detailed planning for the FOT&E is proceeding. An extensive amount of APR-39A(V)2 operational testing will occur in FY01. Data collected and reported in these results will help to determine if the systems should be deployed and serve the Program Manager in executing follow-on contract award options for additional units.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

The APR-39A(V)2 program is proceeding as planned. The Program Manager needs to pay particular attention to follow-on platform integration efforts that plan on utilizing existing lead platform (AH-1W) test and evaluation data to support fielding recommendations. In the past, there has been a tendency to rely too heavily upon existing lead platform data and to overly minimize unique platform-specific test requirements. It will become very important for platforms to adequately develop and implement robust test objectives that address unique aircraft platform integration and system-level performance. Each follow-on platform should plan on testing the integrated system's operational effectiveness and suitability, and perform an assessment of upgraded performance against what is currently fielded. Integrated platform performance should be assessed as operationally effective and suitable prior to the system receiving recommendation for fielding.

ROLLING AIRFRAME MISSILE (RAM) WEAPON SYSTEM



Navy ACAT II Program		**Prime Contractor**
Total Number of Systems:	1,315 Blk 0 missiles. 3,195 Blk 1 missiles. 710 Blk 1 retrofit kits. 156 Launchers	Raytheon Systems Company, Tucson, AZ
Total Program Cost ((TY$):	$3,786.1M	
Average Unit Cost (TY$):	$0.273M Blk 0 $0.444M Blk 1 $4.4M GMLS	
Full-rate production:	Block 0: FY94 Block 1: FY00	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Rolling Airframe Missile (RAM) program is designed to provide surface ships with an effective, low-cost, lightweight, self-defense system that will provide an improved capability to engage and defeat incoming anti-ship cruise missiles (ASCMs). The RAM Block 0 has a five-inch diameter airframe that rolls in flight and dual mode, passive Radio Frequency/Infrared (RF/IR) guidance. Initial homing for RAM Block 0 is in RF, using an ASCM's RF seeker emissions. If the ASCM's IR radiation is acquired, RAM transitions to IR guidance. RAM Block 1 uses an improved, electro-optical proximity fuze and a new IR seeker, and can be launched in an IR all-the-way mode as well as the dual mode (passive RF, followed by passive IR) used by Block 0. Block 0 rounds are being configured with the new electro-optical fuze used in RAM Block 1. The launching system and missiles comprise the weapon system.

RAM weapon systems are integrated with the AN/SWY-2 or -3 combat system on certain ships and with the Ship Self Defense System (SSDS) Mark 1 on other ships. The AN/SWY-2 is comprised of the weapon system and the combat direction system. With the SWY combat system, RAM has targets assigned or designated to it by the Mk 23 target acquisition system radar operational computer program. This program integrates ship sensor information and performs threat evaluation and weapon assignment on DD 963-class, LHA-class, LHD-class, and CV class ships. Within the AN/SWY-3 combat system, RAM provides a short-range air defense capability, with the NATO Sea Sparrow system providing longer range protection. For CVN-class and LPD 17-class ships, it is planned for the Cooperative Engagement Capability to integrate radar information and provide threat evaluation. SSDS MK 2 will perform weapon assignment. For LSD 41-class ships, the Ship Self Defense System MK 1 integrates ship sensor information and performs threat evaluation and weapon assignment. For example, on LSD 41 class ships, a typical SSDS engagement suite includes RAM, the PHALANX Close-In Weapon System Block 1A, and the decoy launch system. SSDS further integrates the AN/SPS-49(V)1 radar with the medium pulse repetition frequency upgrade, the AN/SPS-67 surface search radar, the AN/SLQ-32(V) sensor, and the CIWS search radar. The RAM weapon system will be upgraded with a RAM Helicopter-Aircraft-Surface (HAS) target mode.

RAM Block 0 contributes to the ***Joint Vision 2020*** concept of ***full-dimensional protection*** by enhancing ship self-protection against several RF-radiating ASCMs that have "leaked" past outer air defenses. RAM Block I extends that protection against several non-RF radiating missiles. Given that some of the ships using RAM are also platforms from which strike operations are executed, RAM indirectly contributes to the concept of ***precision engagement***.

BACKGROUND INFORMATION

The Navy established an operational requirement for the RAM weapon system in 1975. The Federal Republic of Germany and the United States signed a memorandum of understanding for joint participation in the advanced development phase of the program. IOT&E was completed in FY90. The DOT&E assessment was reported in DOT&E's FY90 Annual Report. As noted in that report, a B-LRIP report had been prepared for RAM but a final decision to proceed beyond LRIP had not been made. Due to this deferred decision, the B-LRIP report was not forwarded to the congressional defense committees until April 1994, prior to Block 0 missile and launcher full-rate production. The B-LRIP report concluded that the RAM weapon system was operationally effective against the preponderance of RF-emitting ASCMs, although there were exceptions. It also concluded that RAM Block 0 was not operationally suitable. These deficiencies were addressed prior to the decision to proceed beyond LRIP, with the new Block I missile program addressing the more fundamental deficiencies.

RAM Block 1 OPEVAL was completed on the self defense test ship in August 1999. Results of that OPEVAL supported the conclusions in DOT&E's B-LRIP and LFT&E report that RAM Block 1 is operationally effective and lethal against most current ASCMs, and is operationally suitable. An accompanying caveat was that the conclusions could not be decoupled from the combat system (that for the LSD 41-class of ships) that was simulated on the self defense test ship.

TEST & EVALUATION ACTIVITY

Activity consisted of planning for FOT&E of RAM Block 1 and for T&E of the RAM HAS target mode.

TEST & EVALUATION ASSESSMENT

RAM Block 0. Our assessment of RAM Block 0 remains that it is operationally effective against most of the RF-emitting ASCMs and that it is operationally suitable. Performance against targets executing evasive maneuvers has not been tested because these targets were not available, nor was the SDTS available for OT of RAM Block 0 against the most realistic threat attack profiles.

RAM Block 1. RAM Block 1*, as supported by the SSDS Mark 1, integrating an AN/SPS-49A search radar, a CIWS Block 1B, and an AN/SLQ-32(V)3 electronic warfare system,* is operationally effective against most current ASCMs. *The CIWS Block 1B radar was essential in tracking targets and supporting RAM Block 1 launches. By no means can the operational effectiveness assessment of RAM Block 1 be divorced from the combat systems suite used in testing.* RAM Block 1 is operationally suitable. RAM Block 1 is lethal against most current ASCMs.

Assessment of RAM Block 1 when supported by other combat systems (especially any without CIWS Block 1B) will require independent OT with that particular combat system on this or a follow-on SDTS. RAM Block 1 capability was examined against representative targets from all ASCM threat categories but one. That category is projected to have slow expansion and is currently populated by a single threat. A surrogate target is being developed for FOT&E to investigate RAM Block 1 capability in this category.

The FOT&E program for Block 1 needs to address the following, extracted from our B-LRIP report:

- Missile capability against the threat category that was not tested during OPEVAL.
- Missile survivability after the requisite storage time in a shipboard launcher.
- Missile capability against ASCMs under conditions of EA to the combat system sensors, low visibility (high aerosol environment), and other IR sources.

RAM HAS Mode. The RAM program sponsor directed initiation of efforts to use inherent Block 1 capabilities, via software modifications, to enable engagement against helicopter, aircraft, and surface targets. This direction stipulates that resident Block 1 ASCM capability is to be retained. It is understood that the program sponsor intends to issue detailed performance goals for the RAM HAS in FY02 after completion of a performance characterization/evaluation phase. More definitive operational requirements are critical for laying out an effective T&E program, given the absence of an ORD. The T&E program for the HAS mode will address retention of Block 1 capability against ASCM threats.

LESSONS LEARNED

The OPEVAL of RAM Block 1 is considered the most operationally realistic and stressful testing of a Navy air defense missile system—ever. That this was achieved is due both to the Program Manager's cooperation in obtaining threat-representative targets and the availability of the SDTS. This unique test asset allowed thorough examination of RAM Block 1 within its intended operational environment. Significant information regarding capabilities and limitations was learned during this operationally realistic testing, which could not have been obtained otherwise, short of use in combat.

SEAWOLF SSN 21 CLASS ATTACK SUBMARINE AND AN/BSY-2 COMBAT SYSTEM

Navy ACAT IC Program

Total Number of Systems:	3
Total Program Cost (TY$):	$13185M
Average Unit Cost (TY$):	$2828M
Full-rate production:	N/A

Prime Contractor

General Dynamics Electric Boat Division-SSN 21
Lockheed Martin-AN/BSY-2 (V)

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The SEAWOLF (SSN 21) Nuclear Attack Submarine was developed to maintain the U.S. technological lead in undersea warfare well into the 21st century. It is designed to rapidly deploy to militarily important hostile ocean areas and deny their use to the enemy, clear the way for strikes by other friendly forces, and engage and destroy enemy submarines, surface forces and land targets, supporting ***dominant maneuver*** as well as ***full-dimensional protection*** for afloat forces. Secondary missions are mine and special warfare. SSN 21 is designed to be a quiet, fast, heavily armed, shock resistant, survivable submarine, outfitted with the AN/BSY-2 Submarine Combat System.

The AN/BSY-2 Submarine Combat System is designed to support SSN 21 in all mission areas. It is required to track targets, platforms, and weapons. These characteristics will provide intelligence and strike capabilities to support the Joint Force Commander in ***precision engagement*** as well as provide ***full-dimensional protection***. The combat control subsystem provides setting and control of weapons and mines, over-the-horizon targeting, combat systems management, and piloting and navigation functions. It includes the weapon launch equipment to support eight horizontal tubes, a vertical large screen display, and own ship data displays. More specific information is included in the classified version of this report.

BACKGROUND INFORMATION

The SSN 21 program began in 1982 and was approved for conceptual design in 1983. In December 1983, the preliminary design was authorized; it was completed in 1985. Approval for lead ship production was granted in 1988.

The DAB ADM for the SSN 21 Program Review decision of January 11, 1991, approved continuation of LRIP through completion of OT in FY98 (now scheduled for FY00). DOT&E's input to that decision was based upon an independent evaluation and assessment of projected performance of SSN 21. DOT&E identified several important aspects of performance without which SSN 21 may not achieve and retain the advantage over the projected threat. A detailed discussion of these aspects was published in the classified FY90 edition of this report. Performance changes due to programmatic changes to supporting systems are discussed in the FY95 Annual Report.

SSN 21's initial sea trials were delayed by concerns about the robustness of the titanium used in some of SEAWOLF's watertight integrity applications. This was partially resolved and SEAWOLF began initial sea trials in July 1996. On her second trial, a casualty to the Wide Aperture Array (WAA) sonar fairing occurred. The corrective action delayed delivery until mid-1997. Following delivery, USS SEAWOLF began acoustic trials, which were completed in November 1997.

The SSN 21 Live Fire Test and Evaluation (LFT&E) program began on August 16, 1988 when the Secretary of Defense directed the Secretary of the Navy to provide an LFT&E plan to OSD. The Navy LFT&E Plan for SEAWOLF, dated September 21, 1988, featured component and surrogate shock tests and most significantly, a *full ship shock test (FSST) of the completed ship*. Component and surrogate shock tests included underwater explosion tests with major SEAWOLF components installed realistically in large-scale surrogate test vehicles exposed to full design shock levels. DOT&E approved the latest LFT&E strategy, shown in the SEAWOLF TEMP in February 1999.

A summary of SEAWOLF LFT&E activity includes a test in 1990 of a 1/4 scale Shock Model Test Vehicle that underwent underwater shock and hull whipping. A/B-1 tests were conducted in 1995 with shock testing of a surrogate Main Propulsion Unit (MPU) and the WAA sonar fairing. An A/B-1 underwater shock test series of major hull penetrations and related components was conducted at the Aberdeen Test Center in 1998-1999. Testing of smaller hull penetrations has been performed using the Navy's Full Scale Section (FSS-5 and FSS-8) shock test vehicles and Paddlewheel shock test fixture. Extensive shock qualification testing of SEAWOLF internal vital components has been accomplished using Floating Shock Platforms (test barges) and standard Navy shock test machines. As of July 2000, approximately 5,662 SEAWOLF components had been shock qualified, with 700 remaining to be qualified, including some major components such as the Main Propulsion Unit (MPU).

In 1993, as part of its LFT&E program, the Navy developed the "SEAWOLF Program Manager's Plan for Countering Secondary Casualties", associated with secondary weapons effects. Secondary weapons effects are those effects subsequent to initial damage, such as fire, smoke, toxic gases, and flooding.

Congress appropriated funds in FY96 to conduct the FSST, which is the capstone test for certifying combat ruggedness of the ship class. The Navy instead elected to use those funds to help pay for correction of unforeseen problems with the fairing to the ship's WAA sonar. The Navy rescheduled the FSST to FY00 and programmed additional funds to support FSST, but Congress, over DOT&E objections, explicitly removed the FY99 funds allocated for preparations for an FY00 FSST. The Navy has since deleted all SEAWOLF FSST funding from the Navy Future Years Defense Plan.

SEAWOLF spent FY98 in post-delivery shakedown, and then spent FY99 completing a post-shakedown availability (PSA) at Groton, CT. SEAWOLF is currently undergoing Operational Evaluation (OPEVAL) and concurrently preparing for her first major deployment, scheduled to occur in 2001. CONNECTICUT (SSN 22) began sea trials in September 1998, and spent FY99 in post-construction shakedown, entering drydock for PSA in September 1999. CONNECTICUT completed PSA in November 2000 and is now participating in the SEAWOLF class OPEVAL. The third and final SEAWOLF class submarine, JIMMY CARTER (SSN 23), is under construction with delivery scheduled in FY04. JIMMY CARTER will be uniquely outfitted with an additional hull section lengthening the ship for special missions and R&D projects.

TEST & EVALUATION ACTIVITY

DOT&E approved Change 1 to Revision 4 to the TEMP in October 2000. This change aligned initial and follow-on operational testing consistent with agreements reached between the Navy and DOT&E. This realignment has supported the Navy's desire to deploy SEAWOLF as soon as possible by initially testing only those mission profiles that SEAWOLF is expected to use during her initial deployment. Other mission profiles, including Battlegroup Operations, Special Warfare, and Under-ice Operations will be tested before the ship is employed tactically in those mission profiles. Follow-on operational testing will also be needed to assess planned propulsor and sonar improvements.

SEAWOLF completed Acoustic Trials with her anechoic coating installed (December 1999), Hydrodynamic Trials (March 2000), Weapons Systems Accuracy Trials (March 2000), and Launcher Trials (April 2000). SEAWOLF partially completed Target Strength Trials in November 1999.
The BSY-2 Combat System Technical Evaluation (TECHEVAL) was completed in October 2000.

In March 2000, the Navy distributed its report of the 1998-1999 A/B-1 underwater shock test series. Lessons learned from this A/B-1 test series are discussed below. The Navy is preparing a Vulnerability Assessment Report (VAR), as required by the current TEMP LFT&E Strategy, that will provide an overall assessment of the ship's vulnerability to threat weapons that may be encountered in combat. The VAR is to be completed in FY01. A draft version was to have been provided to DOT&E for comment by October 2000, but as yet has not been received. An Independent Vulnerability Assessment will be performed by DOT&E in FY01 after receipt of the Navy's VAR.

The SEAWOLF class OPEVAL is in progress. OPEVAL consists of four phases: Cold Water Operations, Warm Water Operations, Strike Warfare, and Minefield Operations. OPEVAL includes assessment of the SEAWOLF class for mission effectiveness and operational suitability across the spectrum of it warfighting capabilities, except for Battlegroup Operations, Under-ice Operations, and Special Warfare. Both SEAWOLF and CONNECTICUT are participating in various phases of the OPEVAL.

TEST & EVALUATION ASSESSMENT

The FY 96, 97, 98, and 99 Annual Reports chronicle numerous disruptions in the SEAWOLF program which have resulted in delays to the SEAWOLF Test Program, and hence the ship's initial deployment. Some of these delays also interrupted funding for the FSST when the Navy used funds budgeted for the FSST to correct emergent problems to the ship's flank sonar array support structure. Congress then refused again in FY99 to fund the FSST, a move that Navy and DoD acquisition executive leadership accepted, citing the small size of the SEAWOLF class (3 ships), similarities in construction to the LOS ANGELES class, and unnecessary cost. The Navy has also argued that its component shock qualification program and design modeling are sufficiently robust to assure a survivable end product. DOT&E views the Navy arguments against conducting the FSST as untenable due to the advanced design of SEAWOLF, her unique weapons suite, her combat system, her size and her speed. Furthermore, the impact on ship and crew survivability is unknown.

In FY00, several significant equipment/design problems caused disruptions in SEAWOLF's test program, delaying OPEVAL by four months. The BSY-2 TECHEVAL, planned to be completed by May 2000, did not complete until October 2000, caused by failure of a TB-29 towed array, repeated failure of the TB-29 towed array handling mechanism, and uncertainties in the sonar system's ability to automatically track some important submarine target frequencies as designed. Another problem, discussed in the classified version of this report, delayed a live Tomahawk test missile firing from July 2000 to a now-scheduled February 2001 date. SEAWOLF also required drydocking from August to September 2000 to confirm acceptable weld integrity in SEAWOLF's high pressure spherical air flasks. These air flasks are part of SEAWOLF's emergency main ballast tank blow system that is used for rapid surfacing in the event of an emergency, most notably flooding. The welds had come under scrutiny after unacceptable weld defects were detected in two spare air flasks, which the Navy was preparing for component shock qualification testing. To the Navy's credit, component shock qualification testing is continuing to be pursued on SEAWOLF, but this late-emerging problem also underlined that the SEAWOLF component shock qualification program is incomplete, something DOT&E has reported the past several years.

Although the Navy has not gone on record to agree to complete OPEVAL before the ship's initial deployment, its actions to date have supported conducting the OPEVAL before SEAWOLF initially deploys. To help complete OPEVAL, DOT&E has supported test sharing between both SEAWOLF and CONNECTICUT. DOT&E's position continues to be that OPEVAL should be completed and its results promulgated before SEAWOLF's initial fleet deployment in 2001.

In FY99, DOT&E received and analyzed SEAWOLF's pre-PSA acoustic trial report and reported findings in last year's report. SEAWOLF's post-PSA acoustic trial was completed in November 1999, but the Navy did not grant DOT&E analysts access to trials data until late September 2000. Analysis is in progress.

Suitability issues of availability and logistics supportability remain unresolved due to late funding for critical spares and limited fiscal resources for engineering support and correction of major material deficiencies. Many SEAWOLF parts are already out of production, exacerbating this situation. SEAWOLF's maintenance will be expensive even if reliability goals are met.

A November 1999 COMOPTEVFOR Operational Assessment report cited six critical operational issues as high risk for SEAWOLF. These were (1) covertness, (2) weapon launch, handling, and stowage, (3) detection, (4) tactics, (5) survivability, and (6) enhanced modular signal processor. The survivability risk is attributed to the lack of understanding caused by the absence of the FSST, and COMOPTEVFOR recommends conducting this test. COMOPTEVFOR also notes that there have been numerous failures in component-level shock tests. Once those failures have been corrected, a full ship shock test is justified to examine interfaces between components and system-of-systems issues. DOT&E agrees with this assessment, and notes that most of these concerns have been articulated to varying degrees in this report for the past several years. The Navy has plans in place to alleviate these risks in the long term, with the exception of ship and crew survivability. More details are provided in the classified version of this report.

DOT&E believes that omission of the FSST places SEAWOLF's combat survivability in question. Ship shock tests have historically revealed serious, but correctable, design deficiencies that component testing, modeling, simulation, or analysis alone did not detect. For example, the A/B-1 shock test series identified shock deficiencies, confirmed corrective actions, and provided valuable lessons learned for major hull penetrations. One of the major purposes the FSST serves is to provide some reasonable degree of assurance that all components acting together as a system-of-systems perform satisfactorily when exposed to weapons effects likely to be experienced in combat. Another major purpose of the FSST is to help validate computer models used in analysis for shock qualification of major systems such as the MPU. The approach for Verification, Validation, and Accreditation (VV&A) has not been described for models used in support of LFT&E. The FSST has long been the centerpiece of the SEAWOLF TEMP LFT&E strategy that had been mutually agreed upon by the Navy and DOT&E and is essential to a meaningful vulnerability assessment. To date, the Navy has proposed no alternative approach for developing the vulnerability-related information that an FSST would provide.

The Navy is preparing a VAR that will provide an overall assessment of the ship's vulnerability to threat weapons that may be encountered in combat. LFT&E Issues to be addressed include the ship's vulnerability to torpedoes and mines, and the ship's ability to perform its mission after exposure to specified levels of underwater shock intensity. The Navy's report will be based on tests and analyses that have been conducted, but the Navy will not be able to address the LFT&E Issues properly without the benefit of a completed FSST. Without an FSST, the overall SEAWOLF LFT&E program will be incomplete and inadequate. Major aspects of the survivability of the ship will be unknown.

The JIMMY CARTER (SSN 23) design is substantially different from the SEAWOLF (SSN 21) configuration with upgrades that may significantly affect survivability. In addition to lengthening the hull by approximately 100 feet and adding nearly 2500 tons displacement, other modifications include changes to the pressure hull, adding a dry deck shelter, inserting an ocean interface section as well as installation of numerous new systems that should be shock qualified. Therefore, on December 2, 1999, DOT&E designated JIMMY CARTER as a covered product improvement program on the LFT&E oversight list. A new TEMP including a new LFT&E Strategy is required. The Navy has not yet agreed to provide a new TEMP and LFT&E Strategy as requested by DOT&E. DOT&E memorandum to Assistant Secretary of the Navy Research, Development, and Acquisition (ASN (RDA)) dated July 17, 2000 reemphasized the need for a new TEMP and LFT&E Strategy.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

SEAWOLF is a major defense acquisition program, so DOT&E will assess OT and LFT adequacy, evaluate operational effectiveness, suitability, and survivability, and submit final test and evaluation reports to Congress as required by Sections 2366 and 2399, title 10, U.S. Code. DOT&E maintains that assessment of operational effectiveness, suitability, and survivability must precede the decision to operationally employ the SEAWOLF Class During FY00 the Navy has indicated through its actions that it is supporting this course of action. In FY01, DOT&E will continue to work with the Navy to address any emergent scheduling challenges.

DOT&E believes that the Navy must report on the completeness of the SEAWOLF component shock qualification program, and ensure all major components are shock qualified before the ship deploys. This is particularly important since the FSST remains unfunded, and the Navy has argued that its "robust" component shock qualification program is a major justification for not performing the FSST.

The Navy is short of serviceable TB-29 towed arrays. More details are provided in the classified version of this report. It is recommended that the Navy fully budget and the Congress fund all needed TB-29 procurements.

As COMOPTEVFOR recommends, the Navy should budget for and the Congress should fully fund the SEAWOLF class FSST, even if it would now occur after the ship's initial deployment. Furthermore, Congress should remove its restrictions on the conduct of the SEAWOLF FSST. Live fire testing of platforms such as SEAWOLF reveal deficiencies that were previously undetected, but are relatively easily corrected, and will protect the crew during battle. Although the Navy has resisted shock testing SEAWOLF (on the argument of excessive cost versus the small number of hulls), it has agreed to perform the test if it is funded. DOT&E considers the $47 million price tag reasonable when viewed in the much larger context of SEAWOLF's overall cost and added crew safety margin.

The A/B-1 testing experience has demonstrated a particular benefit of the Aberdeen Test Center's Underwater Test Facility. When conducting a long duration test series that would not be feasible or cost effective at sea, the A/B-1 test series enabled the identification of shock deficiencies and subsequent development, incorporation, and successful testing of related design changes, confirming a satisfactory correction of the shock deficiencies. The Navy has assured DOT&E that it intends to implement the design changes developed through A/B-1 testing in all SEAWOLF Class submarines. Shock testing can uncover weaknesses in the design of vital components having major significance in the submarine's function and ability to survive in combat. Such weaknesses in many instances are not costly to correct. Based on this test and similar experiences on USS JACKSONVILLE (SSN 699), similar significant weaknesses affecting the submarine's ability to complete its mission would be uncovered in a SEAWOLF FSST.

Per DOT&E guidance, the Navy should also provide a new TEMP LFT&E Strategy for JIMMY CARTER (SSN 23) to describe the approach for addressing the impact on her survivability of the major modifications being installed in that ship.

The cost cap, which served its purpose to rein in cost growth, continues to adversely impact the future operational effectiveness of the ship since planned enhancements have had to be delayed or scrapped. Cost pressures have also led to the delay or cancellation of important tests. More details are provided in the classified version of this report. Funding these improvements are becoming even more important as total submarine force levels decline.

Unanticipated problems arise in any acquisition program, and in a technologically complex program such problems are to be expected. The difficulty with a fairing on the ship's flank sonar array led first to the delay, and eventually the cancellation of SEAWOLF's FSST. The SEAWOLF program and other Navy programs need to prevent emergent difficulties that arise in one area from canceling important tests in other areas.

Over the years, the Navy has operationally evaluated its submarine sonars and combat systems, but the SEAWOLF OPEVAL is the first-ever ***independent*** look at a US nuclear submarine. This is also the first look at the capabilities of our nuclear attack submarines (*including* VIRGINIA) for the next 25 to 40 or more years. This presents a unique opportunity to identify VIRGINIA problems early, during the SEAWOLF OPEVAL, helping make the VIRGINIA and all the new attack submarines of its class better submarines. Finally, the SEAWOLF needs to be operationally evaluated to better understand her capabilities before she initially deploys as a front-line fleet asset for reasons cited in this report. A better picture of SEAWOLF's effectiveness, particularly when compared to previous U.S. submarines, should emerge after OPEVAL.

SH-60R MULTI-MISSION HELICOPTER UPGRADE

Navy ACAT IC Program

Total Number of Systems:	243	
Total Program Cost (TY$):	$5823.9M	
Average Unit Cost (TY$):	$23.967M	
Full-rate production:	2QFY04	

Prime Contractor
Lockheed Martin

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The SH-60R Multi-Mission Helicopter Upgrade (formerly called LAMPS MK III Block II Upgrade) consists of a Service Life Extension Program (SLEP), avionics improvements, and new or improved mission sensors. The SLEP entails the remanufacture of SH-60B, SH-60F, and some HH-60H airframes currently in the fleet for a resultant life extension of 10,000 hours and a maximum gross take-off weight increase from 21,884 pounds to 23,500 pounds. The program develops the AN/AQS-22 Airborne Low Frequency Sonar (ALFS) and increases sonobuoy acoustic signal processing capability by initial EMD use of the UYS-2A Enhanced Modular Signal Processor and final EMD incorporation of a commercial-off-the-shelf acoustic processor. The acoustic suite is designed to improve USW mission effectiveness against the quiet submarine threat in both deep and shallow water environments. The aircraft will employ a Multi-Mode Radar (MMR) that includes Inverse Synthetic Aperture Radar (ISAR) imaging and periscope detection modes. Other improvements include the ALQ-210 electronic support measures (ESM), a fully Integrated Self-Defense (ISD) system, a Forward Looking Infrared (FLIR) sensor with laser designator, and armament capability to launch Hellfire missiles. The SH-60R and CH-60S will incorporate the “Common Cockpit” which consists of multi-functional displays, keysets, and a complex client-server based tactical data processing system. The upgrade represents a significant avionics modification to the SH-60 series aircraft by enhancing USW, ASUW, surveillance and ID, and power projection, thereby supporting the ***Joint Vision 2020*** operational requirement of ***full-dimensional protection***.

BACKGROUND INFORMATION

The SH-60R Multi-Mission Helicopter Upgrade entered EMD in FY93 and combined the mission functions of the predecessor SH-60B and SH-60F baseline aircraft. A series of cost, budget, and technical issues have prompted program restructures. In May 1999, ASN(RDA) approved exit criteria for the first three SH-60R LRIP lots in FY00, FY01, and FY02. He also designated two of the LRIP Lot 1 aircraft to be used as additional test aircraft and approved exit criteria for full-rate production. The two prototype SH-60R test aircraft were delivered 157 days late to the Navy because of wiring bundle design problems and Common Cockpit software immaturity. The scheduled delivery dates for the first four production representative test aircraft also incurred a 45-day delay due to interface configuration design problems. The Acquisition Program Baseline (APB) was revised in FY00 to accommodate the late aircraft deliveries. The restructured program re-defined the third LRIP lot exit criteria and added exit criteria for a fourth LRIP lot in FY03. The program and APB were restructured to also reflect transfer of test responsibility for a portion of the Common Cockpit hardware and software common to both the SH-60R and CH-60S and to the CH-60S program.

The current program consists of four phases. *Phase one* installed the ALFS, UYS-2A acoustic processor, displays, and control keysets in a SH-60B test aircraft, and focused both DT and OT on mechanical dipping performance of the system. Limited acoustic performance was tested due to the immaturity of the acoustic system's development software. ALFS DT completed in late June 1999 and OT completed in December 1999. ALFS was assessed as potentially operationally effective and potentially operationally suitable. Subsequent phases of test in prototype SH-60R aircraft selectively employed a mixed DT/OT crew to conduct operational scenario-based data collection suitable for both DT and OA purposes. This DT/DT assist testing occurs during the last 30 percent of the DT period and also provides aircraft familiarization for the VX-1 personnel to conduct later dedicated OT flight tests. *Phase two* of the program consists of the DT/DT Assist and OT testing focused on the Common Cockpit and MMR systems installed in two prototype SH-60R aircraft. The DT/DT Assist commenced in May and is projected to be completed in January 2001. Independent OT has slipped from November 2000 to 3QFY01 and may be designated as a DT Assist. *Phase three* consists of a DT/DT Assist and OT focused on the ESM, ALFS, and MMR systems in the two prototype aircraft. The DT/DT Assist testing will start in January and complete in late September 2001. Independent OT will start in October and continue through December 2001. *Phase four* will consist of the DT/DT Assist and OT periods of testing on four production representative aircraft, with the full suite of SH-60R avionics and sensors installed. The DT/DT Assist testing will span the full CY02. Independent OT will start in late March and continue into September 2003. Milestone III is currently scheduled for January 2004.

The Hellfire missile Integration Program Upgrade to the SH-60B and HH-60H aircraft was designated for LFT&E in March 1995. Extensive ballistic testing had been conducted on the H-60 series of helicopters during development and later under the Joint Live Fire Program. A waiver from full-up, system level testing was granted in July 1996. The LFT&E Alternative Plan for the SH-60B and HH-60H included an evaluation of the vulnerability of these H-60 variants based on those past tests. The results of the vulnerability evaluation for the SH-60B and HH-60H, including the effect that the addition of the Hellfire Missile had on vulnerability, were reported in a separate Live Fire report to Congress and summarized in a separate entry in this report. The SH-60R variant was specifically identified as a "covered" upgrade in January 1998. The Navy determined that the waiver granted to the SH-60B and HH-60H aircraft did not apply to the SH-60R, and that a separate waiver must be requested. Because the SH-60R program is currently in EMD, the Acquisition Executive is precluded from granting a waiver without first obtaining legislative relief from the requirement that waivers be granted prior to a program entering EMD.

TEST & EVALUATION ACTIVITY

Operational Testing of the AN/AQS-22 Airborne Low Frequency Sonar System installed in a SH-60B was conducted over a 59-day period from October-December 1999.

Initial DT of the SH-60R began mid-May 2000 and will extend into January 2001. This phase one testing is focused on the Common Cockpit and MMR systems. Electromagnetic interference, compatibility, vulnerability design discrepancies, detected early in DT, have been corrected. Common Cockpit software faults continue and are being corrected through revised software programs. The two prototype aircraft had accumulated over 120 hours of flight test by September 28, 2000.

The Navy and DOT&E determined that important data voids exist that preclude an adequate evaluation of SH-60R vulnerability for LFT&E. DOT&E recognized that the data voids were common to other H-60 aircraft variants such as the Navy's CH-60S and the Army's UH-60L Upgrade, and proposed that the Army and Navy coordinate their efforts to fill these voids so that the total LFT&E data requirement could be met with minimum cost. The Navy and Army are preparing a plan whereby each Service will address some of the data voids and, taken together, all of the data voids will be addressed. DOT&E is reviewing an Alternative Plan that identifies test assets and resources specific to the SH-60R.

TEST & EVALUATION ASSESSMENT

The AN/AQS-22 ALFS system was assessed to be both potentially operationally effective and potentially suitable. The system was accredited with: (1) increased detection ranges and area coverage rates compared to the predecessor AN/AQS-13F dipping sonar; (2) the ability to concurrently process both sonobuoys and active sonar; (3) deeper dip capability due to a longer usable transducer cable; (4) automatic dip depth control features; and (5) a locking device to secure the transducer during tactical maneuvers of the aircraft. The system also exhibited an excessive Built-In-Test (BIT) false alarm rate, an inadequate BIT error reporting format, a below threshold Mean Time Between Mission Critical Failure rate, numerous human factors engineering problems, and insufficient factory training to address the complexity of the system.

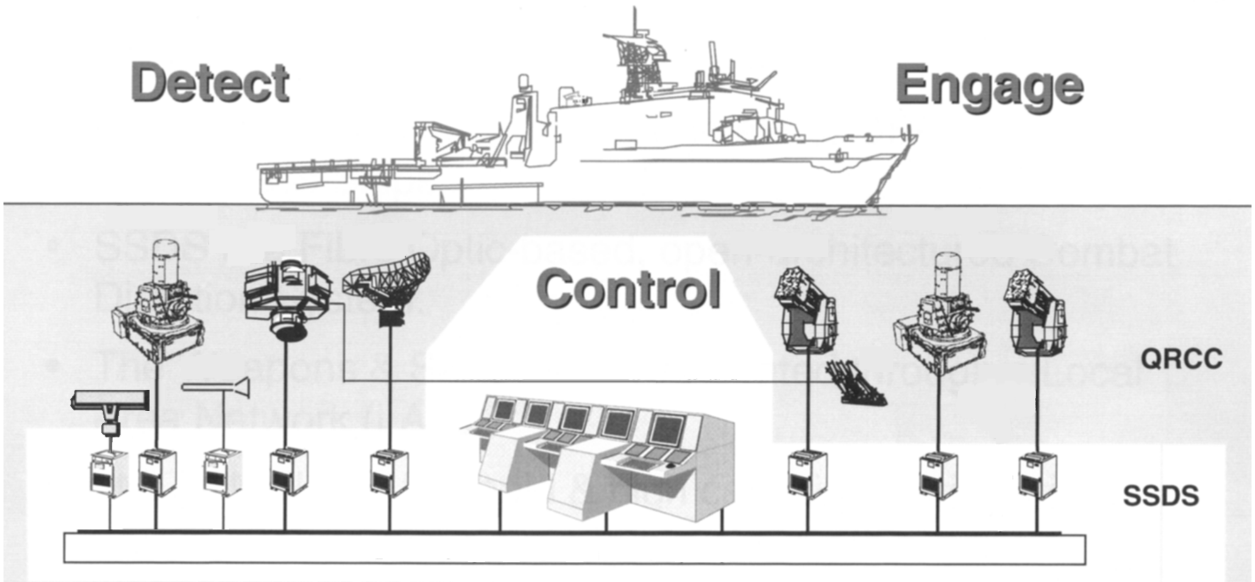
SH-60R programmatic and schedule changes have made it difficult to finalize a revision to the January 1994 TEMP. The August 1992 ORD is also in need of revision. The Program Manager has been forthright in reporting technical and schedule issues, thereby enabling the Systems Test IPT to facilitate test plan adjustments. Combined CT and DT, as well as combined DT and OT, have been planned wherever feasible. A revision to the March 2, 1992 ORD has been prepared and is in the initial stages of staffing in OPNAV. A revision to the January 6, 1994 TEMP is being developed to reflect the ORD revision and program restructuring.

The Audio Management Computer, the MMR, and the Airborne Operational Program software continue to demonstrate low levels of maturity. The generation rate of Program Trouble Reports has exceeded predictions and the number of flight test hours for each test point has not met expectations.

RECOMMENDATIONS, CONCLUSIONS AND LESSONS LEARNED

Development and test of the Common Cockpit system has been a greater technical challenge than originally anticipated. The first DT and OA periods were to focus testing on the Common Cockpit system and on two operator modes of the MMR. Because of the larger than expected generation rate of Program Trouble Reports and flight test hours for each test point, the first OA period has slipped from November 2000 to 3QFY01 and may be designated a DT assist. The DT/OA periods of the SH-60R program are date-based, not event-based. Each period tests available operator modes of the MMR, additional partially developed mission systems as they become available, and additional Common Cockpit interface modules. The date-based portion of the schedule does not sufficiently define functional packages to bound DT and OA efforts. The value of early OTA involvement is maximized when the system(s) to be tested are more clearly defined by an event-based schedule.

SHIP SELF DEFENSE SYSTEM (SSDS)



Navy ACAT II Program		**Prime Contractor**
Total Number of Systems:	58	Raytheon Systems Company
Total Program Cost (TY$):	$823.2M	Naval and Maritime Systems,
Average Unit Cost (TY$):	$10.0M	San Diego, CA
Full-rate production:	FY98	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The principal air threat to U.S. naval surface ships is a variety of highly capable Anti-Ship Cruise Missiles (ASCMs). These include sub-sonic (Mach 0.9) and supersonic (Mach 2+), low altitude ASCMs. Detection, tracking, assessment, and engagement decisions must be accomplished to defend against these threats, with the duration from initial detection of an ASCM to its engagement with weapons typically on the order of a minute or less. SSDS is designed to accomplish these defensive actions.

With radars and anti-air weapons for self-defense of today's amphibious ships and aircraft carriers installed as standalone systems, considerable manual intervention is required to complete the detect to engage sequence against ASCMs. The Ship Self Defense System (SSDS) is designed to expedite that process. SSDS, consisting of software and commercial off-the-shelf hardware, integrates radar systems with anti-air weapons, both *hardkill* (missile systems and rapid fire gun systems) and *softkill* (decoys). SSDS includes embedded doctrine to provide an integrated detect-through-engage capability, with options ranging from use as a tactical decision aid (up to the point of recommending when to engage with specific systems) to use as an automatic weapon system to respond with hardkill and softkill systems (as targets become engageable.) Although SSDS will not improve capability of individual sensors, it enhances target tracking by integrating the inputs from several different sensors to form a composite track. For example, SSDS will correlate target detections from individual radars, the electronic support measures system (radar warning receiver), and the identification friend or foe system, combining these to build composite tracks on targets while identifying and prioritizing threats. Similarly, SSDS will not improve capability of individual weapons, but should expedite the assignment of weapons for threat engagement and provide a "recommend engage" display for operators, or if in automatic mode, initiate weapons firing, ECM transmission, chaff or decoy deployment, or some combination of these.

SSDS integrates previously "standalone" sensor and engagement systems for aircraft carriers and amphibious warfare ships, thereby supporting the ***Joint Vision 2020*** concept of ***full-dimensional protection*** by providing a final layer of self-protection against air threat "leakers" for individual ships. By ensuring such protection, SSDS contributes indirectly to the operational concept of ***precision engagement***, in that strike operations against targets are executed from several of the platforms receiving SSDS.

BACKGROUND INFORMATION

A successful at-sea demonstration of SSDS was conducted with an amphibious ship (LSD-41) in June 1993 as a proof-of-concept exercise at the direction of Congress. Milestone II was conducted in May 1995. Total procurement consists of 58 units, with 48 slated for amphibious ships and aircraft carriers and ten supporting training and engineering development. LRIP consisted of four units. The LRIP decision in late FY96 was supported by an OA conducted by COMOPTEVFOR. OPEVAL of SSDS Mark 1 was conducted during June 1997, in accordance with a DOT&E-approved plan and TEMP to support the B-LRIP decision for procurement of SSDS. Based on OPEVAL results, SSDS is operationally effective against sub-sonic, low altitude ASCMs, and is operationally suitable. The Navy acquisition decision authority granted approval for full production in March 1998. Planning is underway for an upgrade of SSDS to the Mark 2 configuration, which will incorporate functionality of the Advanced Combat Direction System (ACDS) Block 1 and provide the interface for integration with the Cooperative Engagement Capability. FOT&E of Mark 1 was conducted onboard the remotely controlled Self Defense Test Ship during FY99 at the Naval Air Warfare Center, Weapons Division Sea Range at Point Mugu, CA. A separate phase for examining operational suitability issues will be conducted in FY01.

TEST & EVALUATION ACTIVITY

Mark 1. There was no formal T&E of Mark 1 in FY00.

Mark 2. Activity consisted of further definition of the overall T&E program.

TEST & EVALUATION ASSESSMENT

Mark 1. As a result of FY97 OPEVAL and FY99 FOT&E, Mark 1 is considered operationally effective against most current ASCM raids. It is operationally suitable, although improvement is still required in training and documentation, and the suitability portion of the FOT&E conducted in FY99 remains to be tested (expected to occur about mid-FY01). As a result of the decision to upgrade to Mark 2, the Mark 1 is installed in ships of the LSD 41 class only. SSDS Mark 1 FOT&E must include concurrent testing with the Rolling Airframe Missile Helicopter-Aircraft-Surface mode.

Mark 2. The proposed T&E program includes a land-based test phase at Wallops Island, VA, and at-sea phases on two aircraft carriers and an LPD 17 class ship. Because it is to incorporate ACDS

Block 1 functionality, SSDS Mark 2 will require assessment of performance in different warfare areas than Block 1. These include Surface, Strike, Amphibious, and other warfare areas. Further, the Air Warfare area T&E requires an additional phase to assess ship self-defense against ASCMs. This requires Mark 2 integrating the sensor and engagement sub-systems of the applicable ship class combat systems while engaging ASCMs or acceptable surrogates as targets. Since these are short-range air defense systems, safe and effective testing requires use of a self defense test ship capable of being remotely operated during operationally realistic ship air defense scenarios. Results of these tests will be used to validate M&S to predict the Probability of Raid Annihilation (PRA) for various combat systems. PRA is a ship air (self) defense requirement, where a raid constitutes an attack by anti-ship cruise missiles. This OT&E of SSDS Mark 2 should be conducted concurrently with the phases of self defense test ship testing that will be required of the combat systems for the applicable ship classes: LPD 17, CVN 76, CVN 77, CVN(X), DD 21, and follow-on classes that have a PRA requirement. SSDS Mark 2 OT&E must include concurrent testing with the Rolling Airframe Missile Helicopter-Aircraft-Surface mode.

STANDARD MISSILE-2 (SM-2)

Navy ACAT IC Program

Total Number of Systems:	
SM-2 Blocks I-IIIB:	11,504
SM-2 Block IV:	162
Total Program Cost (TY$):	
Blks I-IIIB:	$8,772.7M
Blk IV:	$889M
Average Unit Cost (TY$):	
Blks I-IIIB:	$0.684M
Blk IV:	$3,069M
Full-rate production:	
SM-2 Blk IIIB:	4QFY96
SM-2 Blk IV:	Did not occur, LRIP only

Prime Contractor
Raytheon Systems Company
Tucson, AZ

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Standard Missile-2 (SM-2) is a solid propellant-fueled, tail-controlled SAM fired by surface ships. It was designed to counter high-speed, high-altitude anti-ship cruise missiles (ASCMs) in an advanced ECM environment. Its primary mode of target engagement uses command mid-course guidance with radar illumination of the target by the ship for missile semi-active homing during the terminal phase. The Block II version of SM-2 includes a signal processor to provide less vulnerability to ECM, an improved fuze and focused-blast fragment warhead that provides better kill probability against smaller, harder targets, and new propulsion for higher velocities and maneuverability. SM-2 can be used against surface targets.

A Block III version of SM-2 provides improved capability against low altitude targets. A modification to this version, designated Block IIIA, extends capability to even lower altitudes. Block IIIA includes a new warhead that imparts greater velocity to warhead fragments in the direction of the target. These SM-2 versions are provided as medium range (MR) rounds that can be fired from Aegis rail launchers, Aegis Vertical Launch Systems (VLS), and Tartar rail launchers. Another MR version, designated Block IIIB, added a passive infrared seeker for an alternate guidance mode. A Block IV version was developed to provide extended range, improved cross-range, and higher altitude capability for Aegis VLS ships, as well as improved performance against maneuvering targets and complex ECM. Block IVA is being developed to provide capability against theater ballistic missiles, although it is planned to retain capability against aircraft and anti-ship cruise missiles providing improved performance against maneuvering targets.

SM-2 Blocks II through IV are long-range interceptors that provide protection against aircraft and anti-ship missiles, thereby expanding the battlespace and jointly contributing to the ***Joint Vision 2020*** concept of ***full-dimensional protection***.

BACKGROUND INFORMATION

Full production approvals for SM-2 Blocks have been as follows: Block II was approved in December 1986; Block III in June 1988; Block IIIA in February 1992; and Block IIIB in September 1996. Block IV was approved for LRIP in May 1995, but further procurement was deferred, pending development of the Block IVA missile (the interceptor for the Navy Area Theater Ballistic Missile Defense (TBMD) program) and Block IVA retention of Block IV capability against anti-air warfare threats. We note that although only early DT/IOT&E of SM-2 Block IV was conducted to support the LRIP decision, its capability has now been demonstrated against supersonic ASCM threat representative targets. However, its capability has not been demonstrated in another important area. The Block IV program was restructured with the intention to proceed to DT&E/OT&E and support a full production decision if technical problems were encountered during development of the SM-2 Block IVA that preclude its retention of Block IV capability (never fully determined) against anti-air warfare threats. While the number of at-sea flight tests is small, those tests have supported partial validation of the model used to predict performance.

OPEVAL of SM-2 Block IIIB was conducted during April 1996, with missile firings by an Aegis cruiser that was completing workup training for deployment. Based on OPEVAL results, we concluded that SM-2 Block IIIB is operationally effective and suitable, although there was degradation in minimum range performance. Our B-LRIP Report was published in August 1996. The minimum range problem was corrected, as demonstrated during FY99 FOT&E.

TEST & EVALUATION ACTIVITY

For Block IIIB, capability in an IR countermeasures environment was investigated during a flight test conducted in October 1999 in conjunction with combat system ship qualification trials of an Aegis destroyer. Block IIIB flight testing is continuing during normal Aegis combat system ship qualification trials. For Block IV, capability against supersonic targets was investigated during two flight tests conducted in December 1999, also during ship qualification trials of an Aegis destroyer. One of these flights was against a low altitude maneuvering target. A third flight test was conducted at sea in November 2000.

For Block IVA development, two Control Test Vehicle (CTV) flights were conducted. CTV-1 was conducted in June 2000 and CTV-2 was conducted in August 2000, with both at the White Sands Missile Range (WSMR), NM. Primary objectives of the tests were met.

TEST & EVALUATION ASSESSMENT

Based on 1996 OPEVAL results, we concluded that SM-2 Block IIIB is operationally effective and suitable, although there was degradation in minimum range performance. FOT&E conducted in December 1998 verified correction of the problem causing the loss of minimum range performance. Further FOT&E was conducted during April 1999, demonstrating capability against an actual anti-ship cruise missile with a Block IIIB that had undergone a more representative storage period onboard a fleet ship. Additional FOT&E was conducted in July 1999 to characterize and understand the potential of fratricide in certain operational environments. Further tests, intended to characterize and understand capability in specific operational environments, are being planned as engineering tests that will be conducted in conjunction with training events.

There is no formal OT program for Block IV because the Navy chose (as the Block IV EMD program was being executed) to initiate development of an SM-2 interceptor for Theater Ballistic Missiles (TBMs). This TBM interceptor (designated Block IVA) would retain the Block IV capability against anti-ship cruise missiles. Consequently, the Block IV program would not proceed beyond LRIP unless technical problems were encountered in the Block IVA development that precluded its retention of Block IV Anti-Air Warfare (AAW) capability. However, since only early IOT&E was conducted in 1994, Block IV AAW capability was never fully determined. Engineering tests are being conducted in conjunction with combat system ship qualification trials, to determine capability of the LRIP round that will be in the fleet. The initial production qualification test of the Block IV in December 1998 identified a process issue associated with the manufacture of the dorsal cable. The process and material selection of the cable was reviewed and changes were made to the material and process.

The Block IVA program, which is part of the overall Navy Area TBMD program, includes a single flight to demonstrate retention of AAW capability in early FY02 at WSMR, followed by at-sea testing against targets more representative of anti-ship cruise missile threats. As this is being written, there is an unresolved issue regarding the target for the flight test at WSMR. The at-sea testing is considered adequate except for the appearance of a new ASCM threat for which there is no credible surrogate to use as a target. LFT&E is discussed under the Naval Area TBMD section.

STANDOFF LAND-ATTACK MISSILE EXPANDED RESPONSE (SLAM ER)

Navy ACAT II Program		**Prime Contractor**
Total Number of Systems:	700	Boeing
Total Program Cost (TY$):	$525M	
Average Unit Cost (TY$):	$500K	
Full-rate production:	3QFY00	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Standoff Land-Attack Missile- Expanded Response (SLAM-ER) is a precision tactical weapon for deployment aboard aircraft carriers and is launched from an F/A-18 aircraft. SLAM-ER is designed to provide standoff precision strike against fixed, high value land targets; secondary targets include relocatable stationary land targets and ships. It should satisfy intermediate tactical needs between long-range cruise missiles and short-range free fall munitions. The improvements provided by SLAM-ER over its predecessor, SLAM, take advantage of new technological innovations to provide naval tactical aircraft with the tools required for ***precision engagement***. These improvements include: (1) longer range to increase survivability of launch and/or control aircraft; (2) reduced susceptibility to countermeasures; (3) increased probability of kill against hardened targets for increased system lethality;

(4) an improved guidance navigation unit with an integrated Global Positioning System and Inertial Navigation System; and (5) improved user interfaces for mission planning, launch and control aircraft.

BACKGROUND INFORMATION

Baseline SLAM is a fielded system with proven combat performance in Operation Desert Storm and Bosnia, while SLAM-ER is intended to provide incremental improvements in range and penetrating lethality. SLAM-ER entered EMD after a Milestone IV/II decision in 2QFY95. In December 1996, the Assistant Secretary of the Navy (RDA) decided to procure the FY96 buy of SLAM in the SLAM-ER configuration avoiding $35 million in future retrofit costs. The LRIP I decision was made in April 1997 with LRIP II made in April 1998 and LRIP III made in August 1999. These three production decisions totaled over 100 missiles. Milestone III and the full-rate production decisions were approved in May 2000.

Since SLAM-ER uses a newly developed titanium-cased warhead instead of the Harpoon warhead used in SLAM, LFT&E was required. The LFT&E strategy in the 1996 OSD-approved TEMP specified three data sources for LFT&E: (1) confined volume testing at the Nevada Test Site (completed in early FY97); (2) three arena tests of warhead fragmentation (completed in FY98); and (3) four sled tests of warhead penetration (completed in FY98). The FY00 LFT&E activity against the ex-USS Dale finished the assessment of previously completed test results, and the preparation of the Director's Live Fire Lethality Assessment.

TEST & EVALUATION ACTIVITY

IOT&E was conducted from May 1998-May 1999. OT-IIA Phase I was conducted as combined DT/OT and three pre-production representative missiles were tested in captive carry mode and subsequently launched at threat representative targets. Phase I testing was conducted for risk reduction before proceeding to OPEVAL; specifically to assess the integration of SLAM-ER on the F/A-18 aircraft and to assess the performance of the SLAM-ER mission planning module on TAMPS. Applicable operational data from Phase I was combined with OT-IIA Phase II data to arrive at final operational test results.

OT-IIA Phase II (OPEVAL) was conducted from August 1998-May 1999 at NAWC China Lake and Point Mugu, CA, onboard USS ABRAHAM LINCOLN CVN 72, USS CONSTELLATION CV 64, and off the coast of Puerto Rico. Eight production representative missiles were launched in 11 attempts against threat representative targets in operationally realistic scenarios. One combined DT/OT shot from a previous test period was included bringing the total number of weapons fired to 9 out of 12 attempts. Based on these test results including weapon boresight and seeker drift errors, poor quality/frozen cockpit video, and excessive multi-path interference, DOT&E was prepared to declare SLAM-ER neither operationally effective nor operationally suitable. The Navy chose to correct the problems discovered during OPEVAL and submit the missile to a new round of tests called the Verification of Correction of Deficiencies (VCD) test phase (OT-IIB).

The SLAM-ER live fire test program began in 1996 and was completed in 1998. Based on data obtained from the lethality tests, DOT&E performed an independent LFT&E assessment on the lethality of the SLAM-ER/WDU-40/B high-explosive warhead. The Director's Live Fire Assessment was completed in FY00, and it was included with the BLRIP Report submitted as a combined document to Congress in May 2000. In the spring 2000, the Navy launched a live SLAM-ER into the decommissioned CG 19 as part of the surrogate LFT&E program for DD 21. The missile struck the ship and penetrated to the forward magazine. Damage was significant.

TEST & EVALUATION ASSESSMENT

DOT&E monitored the operational testing of SLAM-ER and evaluated the test results. It is DOT&E's assessment that the operational test, which included the VCD phase, was adequate to assess the operational effectiveness and suitability of SLAM-ER.

DOT&E focused on the evaluation of specific effectiveness and suitability parameters. DOT&E independently analyzed the test results addressing weapon system accuracy, IIR seeker and data link performance, weapon effectiveness, weapon system reliability, and operational availability. These areas were chosen because of their relative importance in determining operational effectiveness and operational suitability. Advertised limitations in test conduct did not appreciably affect our ability to assess SLAM-ER performance. LFT&E focused on lethality.

OPERATIONAL EFFECTIVENESS

SLAM-ER is operationally effective as tested.

- The weapon meets the probability of missile success requirement and the probability of mission success requirement. All four missile launches were successful. A fifth launch attempt failed to arrive at the target because of test range anomalies and was scored as a No Test condition.

- SLAM-ER meets terminal accuracy requirements. The demonstrated circular error probable (CEP) radial miss distance is within the SLAM-ER requirement.

- The weapon boresight problems observed previously have been corrected and no substantial seeker drift errors were observed in the VCD test results. Additionally, the cockpit video quality is much improved with the VCD changes, and the frozen video problem has been minimized. The effects of multi-path interference are also greatly diminished. The result is that target acquisition by the aircrew is greatly enchanced and the crew workload is less.

The SLAM-ER warhead is lethal when accurately delivered against operationally significant targets. When compared to its predecessor SLAM, the SLAM-ER warhead shows mixed improvement in lethality. In its favor, SLAM-ER has double SLAM's penetration capability to attack hardened targets, and its two fuze delay times are twice and four times the SLAM's single delay, which delays SLAM-ER's detonation until the warhead has penetrated deeper within the target. Also, SLAM-ER's fragmentation lethal footprint against such soft targets as missile sites is slightly larger than SLAM. On the other hand, against such targets as buildings and ships that are killed by blast or overpressure, SLAM-ER is potentially less lethal than SLAM because it generates less blast. Nonetheless, SLAM-ER may have greater lethality against a multi-story building than SLAM because its longer fuze delays allow it to penetrate more deeply into the building before detonation, so less blast vents to the outside.

Although not part of the SLAM-ER LFT&E program, in December 1999 the Navy conducted two SLAM-ER warhead events against a decommissioned ship, the CG-19, off Roosevelt Roads Naval Station, PR, to support the DD 21 LFT&E program. The first event was an internal static detonation of a

SLAM-ER warhead to study its blast and fragmentation lethality. The second was a partially fueled, tactical SLAM-ER missile launched from an aircraft targeted at an IR-enhanced area of the ship. Both shots were executed successfully, and they generated significant instrumentation and damage data. A preliminary assessment of the results indicates that the damage inflicted by these two shots is consistent with the DOT&E assessment of SLAM-ER's lethality. In particular, there was no strong evidence that the damage inflicted on the target was enhanced substantially by the reaction of the titanium warhead casing.

OPERATIONAL SUITABILITY

SLAM-ER is operationally suitable as tested.

- The weapon meets reliability criteria for mean time between operational mission failures.
- It meets the operational availability requirement.
- It meets the Built-In-Test false alarm and probability of correct detection requirements.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

LFT&E test design, conduct, procedures and equipment are deficient in several areas. Live Fire of an all-up-round SLAM-ER on an overland range cannot be conducted due to range safety constraints. Missiles currently have self-destruct mechanisms included in the telemetry (TM) package installed in place of the warhead. As a result, end-to-end testing of overland warhead shots cannot be included in the test strategy. To capture end-to-end performance, testing is accomplished in segments. The results are then collated into a comprehensive evaluation combining the necessary elements of an operational flight. Live shots with TM packages that test launch, cruise, target acquisition, and accuracy are allied with warhead penetration and lethality analysis and testing conducted using the supersonic sled facility at NAWCWPNS China Lake.

The LFT&E used a building block approach to construct a lethality assessment from a variety of technical lethality tests. Although not an original requirement, the lethality assessment would have been more compelling if there had been confirming end-to-end SLAM-ER attacks of actual threat-representative targets using warhead-equipped missiles.

Follow-on testing should be conducted on the automated target acquisition (ATA) modes and are planned for December 2000 and during the early months of 2001. The anti-surface warfare (ASUW) mode will be completed during 3QFY01. Both modes will test the new SEM 1.6 software that will be used in future deployments of this weapon system.

STRATEGIC SEALIFT PROGRAM (SSP)

Navy ACAT IC Program		**Prime Contractor**
Total Number of Systems:	20	Avondale Industries
Total Program Cost (TY$):	$5725M	National Steel and Shipbuilding Company
Average Unit Cost (TY$):	$299M	Newport News Shipbuilding
Full-rate production:	2QFY94	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Strategic Sealift Program (SSP) is a ***focused logistics*** program that provides ships to transport or afloat pre-positioned logistic support for a projected military force. This mission is a vital part of ***dominant maneuver*** in the current power projection environment. The representative cargo per ship encompasses equipment for one-third of a heavy Army brigade task force and its supporting supplies. SSP projects and sustains the force by providing 'strategically mobile forces,' "ready on arrival."

The SSP ships are Large (950 feet long, 106 feet wide, and 55,000 long ton displacement), Medium Speed (24 knots), Roll-on/Roll-off (RO/RO) vessels referred to as LMSR. The sealift ships are expected to be capable of self-sustained RO/RO and Lift-on/Lift-off (LO/LO) operations at a pier and in an In-the-Stream (ITS) scenario through stern and side port ramps to a RO/RO Discharge Facility (RRDF). In addition, the LMSR is required to be capable of self-sustained LO/LO cargo operations in an ITS scenario by interfacing with lighterage.

The LMSR ships are not armed and do not have a combat system. They do have a C^3I suite sufficient to perform their intended mission in conjunction with other naval vessels.

BACKGROUND INFORMATION

The SSP is currently scheduled to deliver twenty ships, five of which are conversions of existing commercial container vessels, and fifteen of which will be newly constructed ships. Officially, there will be nineteen LMSR ships supporting the SSP. The twentieth ship, the USNS SODERMAN, is being converted to an MPF(E) ship and will not be counted as one of the SSP LMSRs. All LMSR ships use common cargo handling systems procured by the Navy. Three contractors are building LMSRs. A performance type procurement description was used. Therefore specific ship configurations differ as the respective builders interpret the mission requirements.

As non-developmental items, DT has been limited, focusing on production assurance testing in conjunction with the builders. Systems and integration testing are witnessed by Navy, U.S. Coast Guard, and American Bureau of Shipping representatives.

The current TEMP was approved in June 1996. In view of the single ship mission and similarities in the LMSR configurations, the Multi-service Test Team decided to treat this program as a single ship class, with four separate "flights." The TEMP outlines a mix of operational test events and operational assessments designed to address the hardware variance between the separate “flights.” An operational test of a conversion and a new construction ship as well as an operational assessment of a conversion and new construction ship is planned as part of the evaluation of this program. To date, two OAs and one OT have been completed.

Operational testing (OT-IIA) of a NASSCO conversion LMSR ship was planned and administered in accordance with the DOT&E-approved TEMP and OT Plan. OT-IIA was conducted during September 1996, aboard United States Naval Ship (USNS) SHUGHART in Savannah, GA and Norfolk, VA. The OT was conducted in conjunction with a planned Army sealift deployment exercise, which moved a representative load of Army equipment (over 1,000 pierside pieces, including tanks, trucks and various helicopters) from the 3d Infantry Division in Savannah, GA to Ft. Story, VA. Over 100 ITS pieces were offloaded at Ft Story, VA.

Results of the OA on the Newport News conversion LMSR, the USNS GORDON, conducted in FY99 will be included in the overall program assessment following OT IIB which is presently scheduled to be completed 1QFY02.

An OA of the first NASSCO new construction LMSR ship, USNS WATSON, was also conducted in FY99. Final results of this OA will be included in the overall program assessment following OT-IIB.

The Avondale new construction LMSR operational test (OT-IIB) scheduled for July 1998, was rescheduled for 1QFY99 due to several production issues, the most significant being the cracked cloverleaf tie downs on the decks of the OT IIB test article, the USNS BOB HOPE. OT-IIB was subsequently rescheduled for 3QFY00 and the USNS FISHER was designated the OT-IIB test article. OT IIB has slipped again due to competing requirements for critical Army units needed for the major portions of the test. The current plan is to conduct OT IIB as part of CENTCOM’s BRIGHT STAR 01/02 Exercise scheduled to be completed 1QFY02.

TEST & EVALUATION ACTIVITY

The Multi-Service Test Team (MTT) spent the early part of this year refining plans for the OT-IIB to be conducted 3QFY00. To potentially reduce the scope of required testing on OT-IIB, plans were developed to capture useful pier-side on-load/off-load data from the BRIGHT STAR 00 exercise in 1QFY00. That effort was intended to satisfy data requirements to assess two of the 17 critical operational issues associated with the SSP. Although extremely useful for providing insights to the Strategic Sealift System, the BRIGHT STAR 00 pier-side data collected were not sufficient to completely satisfy the two critical operational issues being examined. Hence, the scope of OT IIB will not be adjusted based on these data.

OT IIB slipped yet again from the 3QFY00 date due to competing requirements for critical Army units needed for major portions of the test. The MTT spent the last half of this year developing an alternate plan for OT-IIB and updating the TEMP to reflect a change in test strategy. The alternate plan envisions a cost-effective data collection effort from BRIGHT STAR 01/02 and opportune training events where testing and training objectives can be effectively combined. BRIGHT STAR 01/02 is envisioned to serve as the culminating OT-IIB event. The TURBO PATRIOT exercise conducted in September 2000, an LMSR pierside load of 25th Infantry Division combat equipment destined for In-The-Stream offload at Camp Pendleton, CA while enroute to a JRTC rotation, served as a data collection opportunity. Analysis of the data collected on this exercise is ongoing as of this writing.

TEST & EVALUATION ASSESSMENT

The SSP has not been adequately tested at this point. DOT&E is assessing the SSP relative to the entire Strategic Sealift System (end-to-end performance). Planning factors based on credible LMSR operational data are needed in addition to an assessment of LMSR operational effectiveness and suitability. Most likely, the ship will perform as required. To date, no significant deficiencies have been observed in operational testing focused on ship capabilities, however real shortfalls have been observed in load planning and training of personnel for executing the mission, and adequate doctrine is not yet in place to guide execution. In-The-Stream operations (doctrine, training, expected offload flow rate, and stern ramp operations) and crane pendulation are two general areas of concern along with assessment of the HOPE class ship in particular.

ITS is a specific area of concern. It is highly probable that the advantages of LMSR ship performance will be mitigated by existing deficiencies in the Strategic Sealift System. Shortfalls in the lighterage system (capability, inventory, and doctrine) could adversely affect the U.S.'s ability to project power in a timely manner in situations where adequate port facilities are not available. In fact, there are a limited number of ports in key areas of interest that can accommodate an LMSR pierside offload. A study of port access conducted in 1991 evaluated ports worldwide to identify those ports that could accommodate an LMSR. A total of 113 ports were identified as having sufficient depth of water and length of berth to allow pierside offload of an LMSR. Of the 113 ports identified, 54 were in NATO countries, 8 more were in non-NATO western European countries, 13 were in Austria, New Zealand, Japan or Korea and 13 were in Southwest Asia. Of the remaining 25 ports, 9 were in Africa, 8 in Latin America, 3 in China and 1 each in India, Israel, Finland Majuro and Indonesia. This situation is significant in that we may be able to get the force to a crisis in a timely fashion but, in some situations, be challenged to get the force off the ship. The overall class assessment will be made upon completion of the OT-IIB event and will include an evaluation of the ship's ability to unload "in-the-stream" using current capability (presently fielded RRDF) and doctrine. An FOT&E may be required to demonstrate ITS operations in Sea State III when a Sea State III capable RRDF is developed.

Operational testing (OT-IIA) of a NASSCO conversion LMSR ship was planned and administered in accordance with the DOT&E-approved TEMP and OT Plan. OT-IIA was conducted during September 1996, aboard United States Naval Ship (USNS) SHUGHART in Savannah, GA and Norfolk, VA. The OT was conducted in conjunction with a planned Army sealift deployment exercise, which moved a representative load of Army equipment (over 1,000 pierside pieces, including tanks, trucks and various helicopters) from the 3d Infantry Division in Savannah, GA to Ft. Story, VA. Over 100 ITS pieces were offloaded at Ft Story, VA.

The OA on the Newport News conversion LMSR, the USNS GORDON, was conducted in FY99. Initial observations compared USNS GORDON to USNS SHUGHART and determined that the surge load performance would likely be similar to that of the SHUGHART's. One exception noted was greater difficulty in maneuvering HMMVWs with trailers on the GORDON's hoistable decks. This could potentially increase surge load duration. Two recurring deficiencies from OT IIA were the absence of loading manuals to assist the stevedores and crew, and the need for additional training, particularly the Army participants. In addition, a potentially serious problem is that the loaded draft of the USNS GORDON exceeds the 35 feet threshold by a foot or more, restricting entry into marginally capable ports.

An OA of the first NASSCO new construction LMSR ship, USNS WATSON, was also conducted in FY99. Initial observations of the USNS WATSON loadout are: (1) the NASSCO new construction LMSR ships are easier to load compared to the two classes of conversion LMSR ships previously evaluated; (2) the NASSCO new construction LMSR ship holds approximately one-third more cargo than two conversion classes of LMSR ships; (3) efficient stow planning was hindered by inaccurate ship data (repeat finding); and (4) the final stowage plan did not appear to take full advantage of all available space (either additional equipment could have been stowed or available space could have been used to facilitate the exercise and maintenance of pre-positioned equipment).

Based on the results of OT-IIA, the NASSCO conversion LMSR is assessed to be operationally effective and potentially operationally suitable. No significant deficiencies were observed however issues concerning training, doctrine, ITS interoperability, and load inefficiencies were identified. Limited "in-the-stream" data were collected during OT-IIA. "In-the-stream" data need to be fully developed. The final results of USNS WATSON and GORDON OAs will be reported as part of the overall assessment of the Strategic Sealift Program, which is due upon completion of OT-IIB.

OT-IIB, presently envisioned to be conducted during CENTCOM's BRIGHT STAR 01/02, is designed to examine the Avondale new construction ship as part of the strategic sealift system and focused on the surge sealift mission. The Multi-service Test Team is still examining alternatives for demonstrating ship offload "in-the-stream" for the HOPE class ship. The overall program assessment will address all ship configurations from all three prime contractors.

SUBMARINE EXTERIOR COMMUNICATIONS SYSTEM (SubECS)

Navy Program (no ACAT)		**Prime Contractor**
Total Number of Systems:	68	Various
Total Program Cost (TY$):	$689M	
Average Unit Cost (TY$):	$12M	
Full-rate production		
Phase I:	4QFY01	
Phase II:	4QFY03	
Phase III:	3QFY05	
Virginia ECS:	4QFY07	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Submarine Exterior Communications System (SubECS) is an umbrella program, which integrates fifteen smaller acquisition programs and Commercial Off-the-Shelf (COTS) components into a system that supports Network Centric Warfare. The goal of this effort is a communications system that is common across all submarine classes, and which is ***interoperable*** with the planned DoD C^4I infrastructure, and will support the Navy's Copernicus Information System Architecture, the Joint Technical Architecture (JTA), the Global Command and Control System Maritime (GCCS-M), and the Joint Maritime Communications System (JMCOMS).

SubECS supports ***information superiority*** by improving data throughput to and from the submarine using new antennas, advanced processing, new transceivers and waveforms, and new information technology networks. SubECS will also support the steady infusion of new technology and the modernization and replacement of obsolete equipment to allow prompt, sustained and synchronized operations with Joint US and multinational forces, ensuring that the submarine force is a major contributor to ***full spectrum dominance***.

BACKGROUND INFORMATION

SubECS upgrades the communications systems of all existing and planned submarines (SSN 688 Class, Seawolf Class, Trident Class, and Virginia Class) and is being fielded in four major phases. Phase 1 will provide increased interoperability, data rate, and aggregate throughput to the submarine; Phase 2 will provide enhanced message processing and distribution; and Phase 3 will replace remaining legacy transceivers and cryptographic hardware with digital modular radios and programmable cryptographic solutions (PMCS). During these phases, software and hardware upgrades to equipment from previous phases will be implemented as necessary to keep up with commercial technologies. By Phase 3, a functionally common radio room baseline will exist for all in-service submarine classes. The Virginia Class (SSN 774) Exterior Communications System (ECS) is being developed and integrated as part of new construction using the construction shipyard as the integrator. The Virginia ECS will build on SubECS Phase 3, and is Phase 4 of SubECS. The goal for the out-years is that all in-service submarines will be upgraded to the Virginia ECS plus any necessary technology insertions, maintaining a common state-of-the-art radio room on all submarine classes.

The test concept for SubECS involves operational testing for each smaller sub-component, and end-to-end system testing for each major phase. Each sub-component program will continue to be operationally tested before it is introduced into the Fleet. Each SubECS Phase will undergo a land based Operational Assessment (OA) and land based Technical Evaluation (TECHEVAL), which will be used to certify the system for installation on a submarine. Subsequent to on-board installation, each SubECS Phase will then undergo an at-sea TECHEVAL (for those tests not completed in the land based radio room) and an Operational Evaluation (OPEVAL). The Virginia Class ECS land based testing will occur in the Combat Control System Module (CCSM) Off-hull Assembly and Test Site (COATS) during Virginia class submarine construction at the Electric Boat Company in Groton, CT. At-sea operational testing of the Virginia ECS will occur concurrently with the overall Operational Evaluation of the USS Virginia (SSN 774).

In FY99, the Navy consolidated the in-service submarine ECS backfit program with the Virginia ECS new construction program under a single program manager, directly accountable to the Program Executive Officer for Submarines. This arrangement was designed to reduce overall risk across and enable the Navy to more efficiently achieve a programmatic plan that can support a common submarine ECS architecture within the next decade. Driven by the need to reduce costs, this realignment is part of a larger Navy effort to rearrange its submarine acquisition and engineering support functions wherever possible along functional instead of submarine hull-specific lines.

To further reduce Virginia ECS risk, the Navy is evaluating an early build of the Virginia ECS for possible at-sea testing as part of SubECS Phase 2 on SSN 23, utilizing the construction shipyard as the integrator during new construction. The tentative plan would then upgrade SSN 21 and SSN 22 during each ship's Shipyard Restricted Availability (SRA). Final decisions on this milestone change will be dependent on contract negotiations with the construction shipyard, which are in progress. Fielding of a Virginia Class variant on SSN23 could allow for the consolidation of SubECS Phase 2 and 3 with the Virginia Class ECS, yielding a direct path from Phase 1 to the Common Submarine Radio Room. These potential programmatic changes will be finalized by 2Q01 and documented with an update to the SubECS Capstone Test and Evaluation Master Plan (TEMP).

TEST & EVALUATION ACTIVITY

In March 2000, DOT&E approved the Capstone TEMP and tasked the Navy to revise the TEMP by April 2001 due to anticipated changes in the Navy's acquisition strategy. The new strategy is expected to essentially freeze SSN 688 class radio room development at SCSS Phase 1, and move directly to a common submarine radio room among all submarine classes, based on the Virginia Class ECS.

In April 2000, the Navy approved the Submarine High Data Rate (SubHDR) Antenna Operational Requirements Document, which supports Extremely High Frequency (EHF), Low Data Rate and Medium Data Rate (LDR/MDR), Super High Frequency (SHF), and Global Broadcast System (GBS) communications. In August 2000, the Navy approved the SubHDR TEMP.

In June 2000, follow-on Operational Test and Evaluation (FOT&E) was satisfactorily completed in the Trident submarine variant of the Submarine Low Frequency (LF)/ Very Low Frequency (VLF) Versa Module European Bus (VMEbus) Receiver (SLVR), which incorporated the new KOV-17 embedded encryption device, a space-savings improvement. SLVR is now being introduced to fleet Trident submarines and to some Los Angeles submarines. Additional FOT&E is needed for Los Angeles class submarines with automated equipment and antennae alignment switching installed.

In 4Q00, developmental testing was conducted on the SLVR Range Extension Mode (REM). The REM is planned for future installation on both Trident SSBNs and SSN-688 SSNs.

In 3Q00, Land based testing of the Submarine High Data Rate (SubHDR) Antenna was conducted at the Land Based Submarine Radio Room (LBSRR) and the Submarine EHF System Integration Facility (SESIF) in Newport, RI.

In August 2000, the first SubHDR antenna installation was completed in USS Providence (SSN 719). Installation testing is in progress

The first SubECS system level developmental testing (Phase 1) is scheduled for 3Q01 at the LBSRR in Newport, RI. At-sea operational testing is tentatively scheduled for 1Q02 on a Los Angeles class submarine.

TEST & EVALUATION ASSESSMENT

Operational testing occurred on SubECS sub-components in accordance with their individual Navy-controlled TEMPs, but no SubECS integrated phase tests occurred in FY00 due to budget cuts to the SubECS program. Of note, all FY00 operational testing was successful. The first integrated test (Phase 1) should begin in late FY01 or early FY02.

The most significant FY00 event in the SubECS program was the approval of the SubECS Capstone TEMP, which culminated a five year of effort by DOT&E and the Navy to achieve a focused, overall SubECS program test strategy. The introduction of a Capstone TEMP will provide Virginia and all in-service submarines with a framework in which formal communications system requirements can be addressed. However, the Navy's C^4I acquisition practices, with shorter and shorter generation cycles, continue to make test discipline difficult, particularly with the introduction of COTS.

The FY99 Annual Report cited the Virginia ECS as moderate risk with concerns about interoperability, the high rate of change in the Navy's C^4I acquisition practices, short acquisition cycles, and reduced equipment rack space. The Virginia ECS program implemented a phased delivery approach to mitigate risk that delays the selection of a final configuration as long as possible to reduce changes, both anticipated and unanticipated, in the Navy's C^4I acquisition programs. Virginia's limited ECS space, nine racks versus fourteen on SSN 688, also makes it important to delay Virginia's final configuration as long as possible in order to take best advantage of the latest miniaturization developments. DOT&E continues to evaluate the Virginia ECS risk as moderate but acknowledges that the Navy's approach appears sound. Navy initiatives to field an early Virginia ECS build on the Seawolf class, if funded, would further reduce risk, at least to the Virginia class ECS.

Significant delays in the launch of MILSTAR satellites has pushed complete SubHDR antenna operational testing to several years past the fleet introduction date, which has added risk to the SubHDR Program. The Navy has decided to operationally test the Sub HDR antenna in FY01 as much as practicable, and proceed on with fleet introduction (a budget-driven decision), even thought the antenna's higher data rate capability cannot be tested until FY03, when a MILSTAR satellite hopefully will be operational and available. DOT&E agrees that this course of action, although not ideal, is a reasonable approach.

DOT&E continues to monitor and work with the SubECS program office, the sponsors (OPNAV N77 and N61), and both the Seawolf and Virginia programs to keep focus on submarine C^4I systems testing. Although progress continues to be made, funding cuts continue to delay milestones.

Specific examples include:

1. SubECS Phase 1 developmental and operational testing have slipped at least six months because of an OPNAV N77 FY00 budget reduction.
2. An OPNAV N6 FY00 budget reduction resulted in an 18 month delay in availability of the SLVR Extremely Low Frequency (ELF) pre-planned improvement (P3I) for integration, TECHEVAL, and OPEVAL in SubECS.

LESSONS LEARNED

Although the use of COTS products in communications systems has the potential to provide the Fleet with needed capability quickly, its use should not come at the cost of inadequate logistics, poor training, and erroneous documentation. Disciplined land based testing before fleet installation with close attention to training and maintenance documentation has resulted in improved test performance during FY00.

The Capstone Requirements and TEMP process can add value by bringing focus to system-of-systems test planning.

T-45 TRAINING SYSTEM (T45TS)

Navy ACAT IC Program		**Prime Contractor**
Total Number of Systems:	169	Boeing
Total Program Cost (TY$):	$5.2B	
Average Unit Cost (TY$):	$25.6M	
Full-rate production:	2QFY95	
SEP Production:	3QFY99	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The T-45 Training System (TS) is an integrated training system with five main subsystems: the T45A/C aircraft, flight simulators, an academics package, the Training Integration System, and contractor logistics support. The T45TS is intended to provide Navy intermediate and advanced student jet flight training, replacing the T-2B/C and TA-4J aircraft and associated training systems. T45TS contributes to the early involvement of training naval aviation aircrew in ***precision engagement*** of enemy forces.

The T45A/C Goshawk, a derivative of the existing British Aerospace Hawk, is a tandem-seat, lightweight, single-engine aircraft modified for aircraft carrier operations. It incorporates an onboard oxygen generating system, a heads-up display, and a weapons delivery capability for training.

The Simulator Subsystem includes the 2F137 instrument flight trainer and 2F138 operational flight trainer. The 2F137 is a ground-based flight simulator, while the 2F138 adds a wide-angle visual display system.

The Academics subsystem is intended to provide an integrated multi-media system capable of training students and instructors under training. Classroom lectures, workbooks, computer-aided instruction, training devices, and audio-visual media are integrated with the simulator and flight training phases.

The Training Integration System is a management information system using computer hardware, software, communications, and peripheral equipment to facilitate efficient scheduling and use of all training resources (including instructors and students), maintain student and instructor records, and manage curriculum and student flow.

The T45TS is intended to support the ***Joint Vision 2020*** objectives of preparing joint warriors to meet the challenges of future battlespace by ensuring that they are properly trained.

Contractor Logistical Support (CLS) will be provided at all levels of maintenance and logistics for the T45TS subsystems. The integrated logistic support resources will be established by the contractor, funded by the Navy, and turned over to the contractor for integrated logistic support management. Boeing is presently the Prime contractor for CLS.

The digital Cockpit 21 upgrade to the T-45A, now designated T-45C, involves replacement of dedicated gauges and data entry panels with two 5-inch square, monochrome multifunction display units in each cockpit. In addition, a dual redundant Military Standard-1553B multiplex data bus is incorporated, along with integration of a display electronics unit and removal of some single purpose analog hardware. A combined Global Positioning System /Inertial Navigation System replaces the standard attitude and heading reference system. Software modifications include improvements to the Heads Up Display in the front cockpit. Presently there are 43 T-45C aircraft operating at NAS Meridian.

BACKGROUND INFORMATION

The T45TS entered EMD in 1984. Initial operational testing (OT-IIA) in November 1988 identified several major deficiencies in aircraft handling qualities during carrier waveoffs and missed arrested landings. Consequently, the program acquisition schedule experienced several slips to allow for redesign of the aircraft by Boeing (then McDonnell Aircraft). Subsequently, OT-IIB in 1990 and OT-IIC in 1991 verified improvement of the identified performance deficiencies. The T45TS was determined to be both operationally effective and operationally suitable, and recommended for fleet introduction during OT-IIC (OPEVAL) in May 1994. The OT&E of the T45TS has been conducted in compliance with TEMP Revision 6, which was approved by DOT&E on July 8, 1997.

TEST & EVALUATION ACTIVITY

OT-IIIB, OPEVAL of the Cockpit 21 upgrade, was conducted from February 98 to August 98 at NAS Meridian. Previous T-45A deficiencies include directional stability, engine surge and “pitch buck” which are not corrected with the Cockpit 21 upgrade and still exist. Major deficiencies from OT-IIIB (OPEVAL) include: 1. Constantly Computed Impact Point mode air-to-ground symbology was incorrectly displayed above the horizon during a dive attack, 2. HUD digital airspeed and altitude readout failures, 3. Standby gyro inoperative during total electrical failure, 4. Incorrect HYD 2 Light logic in OFT, 5. Loss of visual system database lighting – disappearing several times per day. 6.

Wingman wingtip light visible through vertical stabilizer, 7. Mean Time Between Operational Mission Failures (MTBOMF) did not meet threshold of 112.5 hours, 8. No indications or consequences for holding brakes during simulated catapult launch, 9. Blown main mount OFT simulation did not adequately represent severe directional control problems of the actual aircraft.

TEST & EVALUATION ASSESSMENT

A Verification of Correction of Deficiencies (VCD) was conducted from 01 Nov99 to 22 Mar00. A total of 745.3 OFT hours were accumulated during this 29 day period and accomplished all test objectives. This VCD was planned to verify correction of major deficiencies of the naval undergraduate jet flight training system (T45TS) discovered during OT-IIIB relating to reliability of the visual and non-visual OFT and visual replication, configuration, safety and flying qualities of the OFT. All Critical Operational Issues (COI's) were resolved and rated satisfactory. The reliability of the OFT's made impressive improvements, achieving a MTBOMF for the OFT without the visual display of 372.7 hours (threshold 225.0 hours) and 604.8 hours (threshold 112.5 hours) for the OFT with the visual display. All of the major deficiencies from OT-IIIB were corrected except for inadvertent application of brakes during a catapult launch. The OFT simulation of a blown tire was corrected. Since the OFT can now simulate the severe directional control problems associated with a blown main mount during landing rollout, which is the result of holding onto the brakes during a catapult. This and an aggressive training effort to train students in the consequences have met student objectives; thus the COI was redesignated as a minor deficiency. As a result of the OPEVAL and subsequent VCD, the T45TS was determined to be operationally effective and operationally suitable.

TACTICAL AIRCRAFT MISSION PLANNING SYSTEM (TAMPS)

Navy ACAT III Program		**Prime Contractor**
Total Number of Systems:	3,485	BAE, North America
Total Program Cost (TY$):	$61M	
Average Unit Cost (TY$):		
CVIC Server System:	$200K	
Single Seat Version:	$45K	
Full-rate production:	1986	
SEP Production:	3QFY94	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Tactical Automated Mission Planning System (TAMPS) is a computer-based method for weapons planning and optimizing mission routes against hostile targets. TAMPS version 6.2K (Y2K compatible) is employed extensively by embarked Navy and Marine Corps mission planners to achieve ***information superiority*** for the ***dominant maneuver*** force of naval tactical aviation. TAMPS is designed to provide a common automated system for rapidly processing large quantities of digitized terrain, threat and environmental data, aircraft, avionics, and weapon systems parameters that assist in the ***precision engagement*** of enemy forces. The system has an intended capability to meet the tactical mission planning and digital data upload requirements of fixed and rotary wing aircraft, standoff weapons, avionics systems, mission support systems, and unmanned air vehicles.

TAMPS core software is designed to allow flexible interfaces to a wide variety of USN and USMC C^4I systems in order to provide users near real time updates to weather and intelligence data bases. A modular, open system architecture was developed to satisfy specialized aircraft weapons and avionics systems requirements while maintaining consistent displays and user interactions across all platforms. Platform unique requirements are provided via a Mission Planning Module (MPM) system that integrates platform developed MPMs with appropriate core libraries and servers providing a complete planning environment for any user platform. This integrated MPM planning environment is used to develop, analyze, and store missions as well as create mission planning products (including digital loads, strip route charts, and pilot kneeboard cards) supporting tactical aviation combat operations.

The current Mission Planning Local Area Network configuration for TAMPS, installed aboard each of the aircraft carriers, consists of an Enterprise 4000 server in CVIC with Sun Ultrasparc 12/1300 workstations located in CVIC and in the Ready Rooms. There is also a Sun Ultrasparc 2300 backup server with three PC-based systems in CVIC, as well. The Sun Ultrasparc systems have upgraded memory, improved processing speeds, and increased system stability over previous hardware.

BACKGROUND INFORMATION

Originally, TAMPS updated the Strategic Air Command's Deployable Aircraft Planning System which supported A-6 and F/A-18 mission planning in December 1985. No IOT&E was conducted prior to fleet release aboard USS Carl Vinson in 1986. Responsibility for TAMPS was transferred to the Program Executive Officer for Tactical Aircraft Programs in August 1991.

TAMPS S/R 6.0.5 was determined to be not ready for full operational test at the OTRR in May 1996. TAMPS 6.0.5 was to be fully tested in support of F/A-18 Operational Flight Program (OFP) 11C; but COMOPTEVFOR raised concerns about system stability and human machine interface issues discovered during a DT assist period. As a result, the planned test period in October 1996 was downgraded to an OA with recommendation for no more than a limited fleet release to those units with OFP-11C and critical data upload requirements.

In February 1998, TAMPS 6.1/6.1.1 was found operationally effective as a mission upload device for supported weapons. However, 6.1/6.1.1 was found not operationally effective for strike planning, threat representation, cockpit quality outputs, environmental effects analysis, and joint interoperability. Version 6.1 was also found to be operationally suitable on DTC hardware, but not suitable on portable hardware, and Version 6.1.1 was found to be suitable on new Sun Ultrasparchardware. COMOPTEVFOR reported that a "non-fleet release" recommendation would be warranted if TAMPS was not already widely deployed and required for digital upload of many weapons systems.

Functions examined using TAMPS 6.2K in 1999 were the F-18 Mission Programming Module, F-18 data loading weapon MPMs (JSOW/JDAM, SLAM, SLAM-ER, and HARM), Forward Area Minefield Planning system, F-14 MPM and F-14 data loading, and HH-60 Global Positioning System data loading.

TEST & EVALUATION ACTIVITY

TAMPS 6.2.1 is an upgrade of TAMPS 6.2K which is scheduled for OPEVAL in early 2QFY01. This new version upgrade will be tested on the following functions: 1. Dual redundant LAN capability ensuring backup; 2. Provide a SIPRNET Browsing capability for CVIC/Ready Room connectivity and Online support of Weather, precision guided weapon support and Almanac updates; 3. Enhance a smoother connect/disconnect from the LAN; and 4. Provide new security features. Challenges of the TAMPS program have not been trivial while implementing a re-architecture of the user interface, upgrade of the operating system and undergoing a contractor change after TAMPS 6.2K. The mere fact of being coded in six different script languages, C, ADA, Fortran, SQL, Perl, and C-Shell, have further complicated the integration and implementation issues. T&E of TAMPS will require considerable time and effort, but until an operational Carrier Air Wing attempts to use it in the environment with the operational constraints associated with combat at sea, there will be questions whether it will be operationally effective and suitable in the Fleet.

Since there are three different LAN versions possible, the CV server using a backup Redundant Array of Inexpensive Drives (RAID) and Challenge Athena as the communication pipe, a mini-server with a RAID but with no backup, and a Server Lite that has no RAID or Backup, there are questions that remain as to how and where the program will be tested. The Mini Server is designed for a major shore-base such as required by the USMC or VX-9 and the Server Lite is designed for a squadron level shore detachment. Testing at the Carrier Air Wing level is optimal.

TAMPS is an integral part of the mission planning support system for F/A-18C/D/E/F, F-14D, E-2C, HARM, Joint Standoff Missile (JSOW), Standoff Land Attack Missile Expanded Response (SLAM-ER) and Joint Direct Attack Missile (JDAM). Other key intended functionalities include operations with Global Positioning System, Tactical Electronic Reconnaissance Processing and Evaluation System, Common Operational Modeling, Planning and Simulation Strategy, and the ARC-210 radio. TAMPS has become a critical weapons planning and data upload system while the mission planning has been handed over to PFPS. Current software releases provide basic functionality and system stability has been improved.

TEST & EVALUATION ASSESSMENT

TAMPS has not fully evolved to provide weapons and mission planning. DOT&E expects operators to continue using PFPS (Portable Flight Planning System) for basic mission planning and TAMPS version 6.2K as a mission upload device for more complex mission planning tasks requiring threat analysis terrain data until the final version 6.2.1 is ready for fleet introduction. OTRR is scheduled for January 17, 2000 and OPEVAL will begin immediately thereafter. A Carrier Air Wing at Fallon NV will be utilized by VX-9 to test full integration. With TAMPS 6.2.1's expected release in July 2001, it may be available for that Air Wing's deployment in September 2001.

The fleet will continue to use PFPS for navigation and fuel planning, coupled with TAMPS Precision Guided Munitions (PGM) planning until the Joint Mission Planning System (version 1) IOC in the fall 2002. Version 1 will not provide PGM mission planning, however the follow on version of JMPS will combine all planning tools using the higher order language H1E in January 2003.

T-AGOS / SURVEILLANCE TOWED ARRAY SENSOR SYSTEM (SURTASS) AND LOW FREQUENCY ACTIVE (LFA)

Navy ACAT II/III Programs		**Prime Contractors**
Total Number of Systems:	23	Halter Marine (T-AGOS 23)
Total Program Cost (TY$):	$1495.9M	
Average Unit Cost (TY$):	$60.5M	
Full-rate production:	N/A	(T-AGOS 23 class limited to first ship)

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

T-AGOS/ Surveillance Towed Array Sensor System (SURTASS)/Low Frequency Active (LFA) is an element of the Integrated Undersea Surveillance System (IUSS), providing mobile detection, tracking, and reporting of submarine contacts at long-range, thereby contributing to the operational concepts of ***full-dimensional protection*** through ***information superiority***. The current or baseline sensor is a long array of hydrophones towed by a dedicated non-combatant ship designated T-AGOS. There are three significant upgrades planned. One upgrade, the Acoustic Rapid Commercial-Off-The-Shelf (COTS) Insertion, is designed to process both IUSS and SURTASS acoustic data. The Littoral Low Frequency Active upgrade is a compact LFA system designed to be backfitted on three SWATHs and includes a deployable variant. The third upgrade is the TB-29 Twin Line Array, a common (surface and submarine communities), low cost array providing high performance in both deep water and littoral environments. The SURTASS system includes several passive array variants; the original production array, a reduced diameter array; a COTS A180R array; and a COTS A180R Twin-line for littoral surveillance. The LFA system includes a high power source array for active transmissions. In its final configuration, SURTASS/LFA will be used as either a passive system or in one of two active modes of LFA: monostatic or bistatic receive.

To date, twenty-two ships have been delivered to the Navy, eighteen monohulls and four Small Water-Plane Area Twin Hull (SWATHs). The SWATH design provides greater stability in high sea states and quieting to enhance the performance of the receive array. All but three of the monohulls have been deactivated. The current budget supports eight ships, three monohulls (T-AGOS 8, 9, and 12), four SWATHS (T-AGOS 19-22), and R/V CORY CHOUEST. The T-AGOS 23 class (SWATH) ship is larger than the T-AGOS 19 class ship in order to handle the larger and heavier equipment for the LFA system. Original procurement was projected for up to five T-AGOS 23 class ships, however, the current program is limited to just the first ship.

BACKGROUND INFORMATION

IOT&E was completed in 1992 and 1993 using DOT&E approved test plans. The T-AGOS 19 SWATH platform was found operationally effective and suitable to support the SURTASS Baseline System. The platform was also found to be potentially operationally effective and potentially operationally suitable in supporting the SURTASS Block Upgrade system, which was installed and operationally tested in 1994. The Block Upgrade successfully met all the sonar detection Figure of Merit requirements. Localization and tracking accuracy was satisfactory. The Block Upgrade System was found to be operationally effective and suitable.

In June 1996, SURTASS LFA participated in a major fleet exercise, RIMPAC 96, including the preparatory exercise, TEAMWORK NORTH. The LFA, installed aboard R/V CORY CHOUEST, operated in the open ocean south of the Hawaiian Islands with a U.S. battle group and ships from five allied Pacific nations. In conjunction with the exercise, an OA was conducted which endorsed the use of CORY CHOUEST as an interim fleet asset pending the completion of T-AGOS 23.

In TEAMWORK NORTH, the LFA system detected a foreign submarine while making a transit to the Hawaiian Island area. In RIMPAC 96, LFA performed effectively by detecting all designated exercise participants. The environmental impact of LFA has become a significant issue, and data has been collected to support an environmental impact statement for future use. There is growing concern that testing of all active acoustic detection devices in shallow water ranges may be at risk due to environmental considerations. The lack of an environmental impact statement prevented LFA from being used during RIMPAC 98. SURTASS units did participate, (passive only), in the RIMPAC 98 exercise.

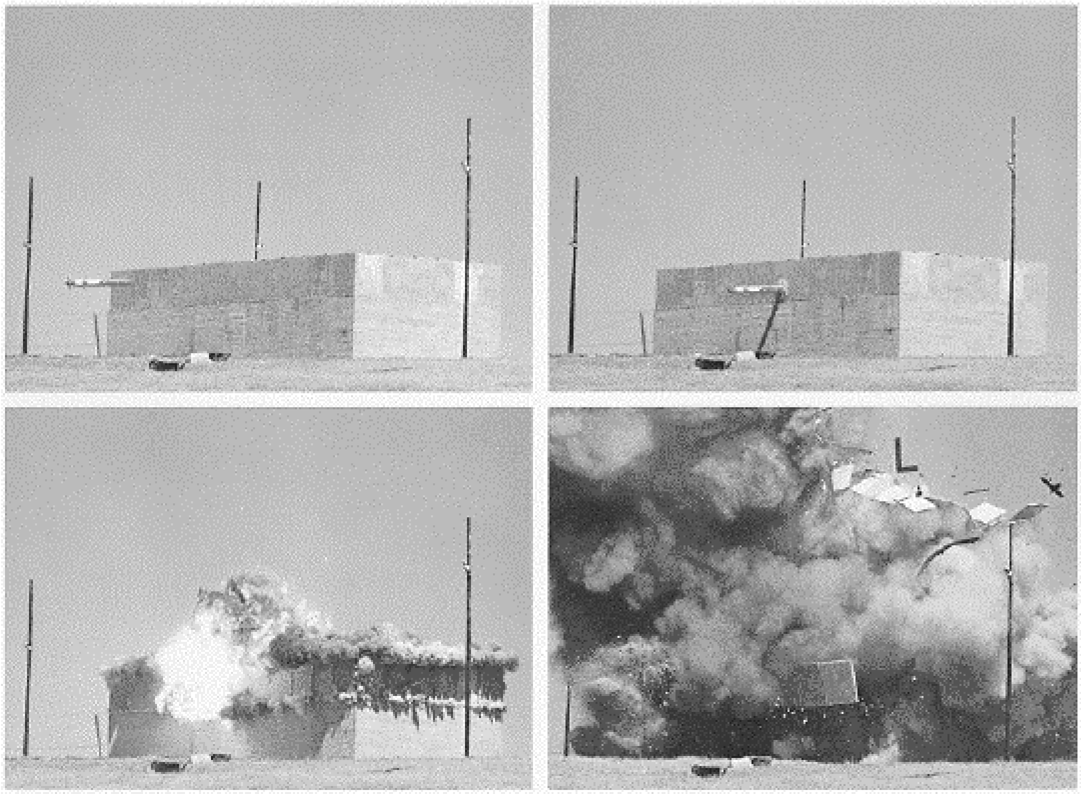
TEST & EVALUATION ACTIVITY

No operational employment of LFA occurred in either FY99 or FY00. The EIS is scheduled for completion in 2001. Further developments and testing will commence once the EIS Record of Decision is completed. Continued slippage in T-AGOS 23 construction resulted in additional delays in the conduct of OT. T-23 was originally planned for delivery in December 1998 but has not yet been delivered. This resulted in cancellation of a planned OA in 4QFY99 and a delay in the SURTASS-LFA OPEVAL on T-23 until 2QFY02.

TEST & EVALUATION ASSESSMENT

Program operational requirement documents and the associated T&E planning documents must be updated to reflect current program upgrades, status and schedule. Operationally, SURTASS is now tasked with providing surveillance and cueing in support of tactical missions in addition to its deep ocean surveillance role. The SURTASS/LFA program must update requirements documents to specifically address this change to direct tactical support. Implementation of COTS technology has resulted in hardware configuration changes that require an update to the TEMP. This update should also describe processing, array configuration and schedule that will be used during T-AGOS 23 DT and OT testing, particularly in regard to bistatic operations. Although Twin Line has been used operationally for five years it has not had an OA. An OA should be accomplished in conjunction with the SURTASS transition to a common (surface and submarine) towed array (TB-29) in a Twin Line configuration.

TOMAHAWK



THE CONVENTIONAL TOMAHAWK, DEVELOPED BY HUGHES MISSILE SYSTEMS COMPANY, PERFORMS HORIZONTAL TARGET ATTACK.

Navy ACAT IC Program

Baseline III and Prior

Total Number of Systems:	2,805 missiles
Total Program Cost (TY$):	$12,481M
Average Unit Cost (TY$):	$1.4M
Full-rate production:	3QFY84

Baseline IV Tactical Tomahawk

Total Number of Systems:	1,365 missiles
Total Program Cost (TY$):	$1,863.4M
Average Unit Cost (TY$):	$1.4M
Full-rate production:	3QFY03

Prime Contractor

Raytheon

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

Tomahawk is a long-range cruise missile designed to be launched from submarines and surface ships against land targets. Three primary variants are currently operational: (1) Tomahawk Land Attack Nuclear (TLAM-N) (not deployed); (2) Tomahawk Land Attack Missile-Conventional (TLAM-C); and (3) Tomahawk Land Attack Missile-Conventional Submunition (TLAM-D). Each missile is contained within a pressurized canister to form an all-up-round (AUR). The submarine AUR is launched from torpedo or vertical tubes. Surface ships employ a vertical launching system (VLS) to launch various missile types, including the Tomahawk AUR. Engagement planning, missile initialization, and launch control functions are performed aboard the launch platform by a Combat Control System (submarines) or Tomahawk Weapon Control System (TWCS) (surface ships). Targeting, mission planning, and distribution of Tomahawk tactical data are supported by the Tomahawk Command and Control System (TC2S).

Tomahawk provides a recognizable example of a ***precision engagement*** system in the U.S. inventory, and has done so since its IOC in 1984. Upgrades leading to the Block III TLAM-C and TLAM-D configurations have improved the system's flexibility. Additional technological innovations are currently in development, and are envisioned to further increase Tomahawk's responsiveness and exploit ***information superiority*** to a very high degree.

BACKGROUND INFORMATION

Development of the Tomahawk began in 1972. The program originally included a Tomahawk Anti-Ship Missile (TASM) in addition to the three land-attack variants. IOT&E began in 1981. DOT&E submitted B-LRIP reports for TASM and TLAM-N in 1984; TLAM-C in 1985; and TLAM-D in 1991.

The Block III upgrades to TLAM-C and TLAM-D include: (1) Global Positioning System navigation; (2) improvements to the terminal update system (DSMAC IIA); (3) time-of-arrival control; and (4) a new warhead for TLAM-C. The Tomahawk Weapon Control System software was also upgraded to a Block III configuration. A major upgrade to the Theater Mission Planning Center (TMPC) (hardware and software) was undertaken at approximately the same time. Operational Test and Evaluation of the Block III AUR was completed in FY92 and TWCS testing was completed in FY93. Operational Test and Evaluation of the upgraded TMPC was completed in FY94. End-to-end FOT&E of the Block III Tomahawk Weapon System (TWS) was also completed in FY94.

Improvements to Block III TWS are ongoing. The most recent upgrades are software version Theater Mission Planning Center 3.1 for the TC2S and further development of the Advanced Tomahawk Weapon Control System (ATWCS). ATWCS is planned as a comprehensive upgrade to the current TWCS, replacing the 1970s vintage hardware and re-hosting/upgrading the software. ATWCS implementation is proceeding in two stages, first replacing the current TWCS Track Control Group then the current Launch Control Group. The ATWCS Track Control Group Replacement (TCGR) OPEVAL was completed in FY99 and introduction of TCGR into the Fleet is proceeding.

The next major upgrade, Baseline IV Phase I Tactical Tomahawk, is in development. The Tactical Tomahawk will be more responsive and more flexible than current variants. The AUR will be equipped with a significantly more capable mission computer, a two-way satellite data-link, and an anti-jam Global Positioning System receiver. The Tactical Tomahawk is to be capable of being redirected to secondary pre-planned targets after launch ("en route flex"). The missile will also be able to receive a new or modified mission plan after launch ("in-flight retargeting"). Meanwhile, the missile will be able to provide information on its in-flight status and confirm arrival in the target area ("battle damage indication"). Improvements to the mission planning and launch platform weapon control systems will reduce the overall Tomahawk planning cycle. Crews aboard launch platforms will be able to plan some types of missions from launch to impact. The EMD contract for the Tactical Tomahawk AUR was awarded in June 1998. The Tactical Tomahawk is currently scheduled to enter Government Developmental Testing in FY02 and Operational Testing in FY03.

TEST & EVALUATION ACTIVITY

Test event OT-IIIE, evaluating the latest TC2S software release, was extended into FY00. Software version TMPC 3.1 introduced the Post-Digital Scene Matching Area Correlator-Global Positioning System (PDGPS) capability. This feature permits the use of the Global Positioning System aiding after the inertial navigation system has received a Digital Scene Matching Area Correlator (DSMAC) update. As a result, inertial navigation system drift is sharply reduced and the accuracy of the DSMAC update can be preserved over greater distances. With PDGPS, the separation between the final DSMAC scene and the target can be increased five-fold (compared with the current allowable maximum) with no loss in terminal accuracy. This capability allows greater flexibility in pairing DSMAC scenes with targets. The mission planning phase of OT-IIIE was conducted at U.S. Pacific Command Headquarters, employing the operators and maintenance personnel of the Cruise Missile Support Activity. Twenty operational missions and one Operational Test Launch (OTL) mission were prepared. After an initial failure (unrelated to the TC2S), the OTL mission was flown in 3QFY00. Changes in the Navy's modeling and simulation directives have necessitated an expansion to the scope of the verification, validation, and accreditation processes associated with the simulations used for validating Tomahawk mission plans. Initial validation of the mission plans is complete, but the Navy is currently assessing the simulations to ensure that they are fully compliant with the expanded accreditation criteria.

Test event OT-IIL, the OPEVAL for the ATWCS Launch Control Group Replacement (LCGR), was conducted in 1QFY00. ATWCS is the surface-ship fire-control system for Tomahawk. The Track Control Group (TCG) element of ATWCS performs data base management, communications, and planning of Tomahawk over-water flight routes. The Launch Control Group (LCG) element of ATWCS selects missiles for launch, controls the integration of the mission data (detailed instructions for the over-land phase of flight) with the selected missiles, and (when authorized) transmits commands to launch the missiles. OT-IIL test activities included: (1) simulation of Tomahawk missions at laboratory site ashore; (2) exercises of command, control, communications, targeting, and engagement-planning; (3) an operational test launch of a Tomahawk missile; and (4) a maintainability demonstration. The last three activities were conducted aboard USS MILIUS (DDG 69).

TEST & EVALUATION ASSESSMENT

In OT-IIL, all COIs were rated satisfactory. No major deficiencies were observed during testing. ATWCS was judged operationally effective and operationally suitable. Two minor ATWCS LCGR deficiencies involved interfaces between elements of the shipboard Tomahawk Local Area Network (LAN). In one case, the Generic Front-end Communications Processor (GFCP) was not in a "ready" condition when ATWCS attempted to process Mission Data Updates (MDUs). The software's time limit for successful communication expired, forcing a reboot of the ATWCS mission data LAN. In this case, USS MILIUS was unable to comply with tasking within the time period specified by the scenario. This problem could have been avoided if the operators had checked on the condition of the GFCP prior to attempting MDU processing. A second interface problem involved a loss of communications between the TCG and LCG portions of ATWCS. This problem arose during multiple salvo tasking. It originated in an excessively high volume of traffic on the LAN because VLS authorizations were being processed concurrently with a high volume of TCG-LCG interface traffic. The interface exceeded its "time-out" limitation and the loss of communications ensued. In this case, USS MILIUS was able to complete tasking, but only after receiving a 60-minute extension to the tasking window. This problem would probably have been avoided if USS MILIUS had begun the VLS authorization process earlier in the scenario. Both of these interface problems were corrected prior to fleet release of the ATWCS LCGR upgrade.

Other minor ATWCS LCGR deficiencies affected Human Factors COIs. The ineffective method of alerting operators to system faults and status transitions was a contributing factor in the interface problems described above. The use of an inconsistent numbering scheme for engagements and engagement plans forced operators into cumbersome off-line administrative procedures to ensure that mission-critical tasks and sub-tasks were properly tracked and processed. Operator workload was increased in an already stressful environment. The information on VLS status provided by ATWCS was in some cases incorrect, not prominently displayed, or not presented early enough in the engagement sequence to avoid subsequent problems. The ATWCS launch consoles have an upper monitor that is not used, while the presentation on the lower monitor quickly becomes cluttered. These minor deficiencies will be addressed in the next ATWCS software build.

Although the EMD contract for the Baseline IV Tactical Tomahawk AUR was awarded in June 1998, this program does not have an approved TEMP or LFT&E Strategy. DOT&E has identified three particular areas in which differences between Block III and Baseline IV Tactical Tomahawk designs, despite use of the same WDU-36/B warhead, could significantly affect system lethality. These areas include fuze modifications, significant structural modification to the new missile, and modified terminal engagement parameters. The program manager, PMA-280, has provided design data that substantially address the concerns over the fuze replacement, which will also be addressed during live-warhead end-to-end flight testing. The modeling effort conducted this year, unsupported by test data, fails to adequately address the remaining two concerns. DOT&E has advised PMA-280 that the required LFT&E Strategy must identify testing to support both validation of the modeling effort and a comprehensive system lethality evaluation. PMA-280 has indicated it plans to propose an LFT&E Strategy at the end of FY00.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

The Tactical Tomahawk Weapon Control System will be required to perform limited end-to-end mission planning aboard the launch platform. This rapid response mode of operations is very different from the layered and lengthy preparations required for current Tomahawk launches and needs to be well tested. The concept of operations for this new capability should be developed with care and the development should include consultations with the test and operational communities. The viability of this process must be demonstrated through stringent and realistic testing.

The Tactical Tomahawk program has been restructured several times since its inception in 1994, necessitating numerous ORD and TEMP updates. The overall Tomahawk program has had difficulty in building consensus for TEMP updates through the IPT process. The proposed updates are consistently late in arriving at DOT&E relative to the commencement of testing. The PEO needs to be more proactive in using the IPT process to ensure that the T&E strategy embodied in the TEMP is understood and agreed to well in advance of the earliest phases of testing.

Repeated restructuring of the Tactical Tomahawk program and a delay in acknowledging the limitations of WDU-36/B warhead development testing have contributed to the Navy's failure to develop an LFT&E Strategy for the Baseline IV Tactical Tomahawk AUR for more than two years after the EMD contract award.

UNMANNED AERIAL VEHICLE (UAV)
TACTICAL CONTROL SYSTEM (TCS)

Joint ACAT II Program		Prime Contractor
Total Number of Systems:	24 USN, 22 USMC, 44 USA, 12 USAF	Raytheon Systems Co.
Total Program Cost (TY$):	$188.7M*	
Average Unit Cost (TY$):	TBD	
Average PA Unit Cost (TY$):	TBD	
Full-rate production:	2QFY01 4QFY05	

**(RDT&E $ only, GCS production funds are managed by each Service separately)*

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Unmanned Aerial Vehicle (UAV) Tactical Control System (TCS) will provide the UAV operator the necessary tools for computer related communications, mission tasking, mission planning, mission execution, data processing, and data dissemination for all tactical and medium altitude endurance UAVs. TCS will support long-range communications from one TCS to another. TCS will provide the tactical commander with ***information superiority***, contributing to the ***full-dimensional protection*** of his force and supporting ***precision engagement*** of the enemy.

TCS is designed to provide the Warfighter with a scalable and modular capability to operate UAVs on existing computer systems and future C^4I processing systems. *Scalable* refers to the ability to provide five levels of air vehicle interaction that range from receipt and transmission of secondary imagery to full functional control of the UAV during take-off to landing. Modularity allows the use of common hardware. It provides the flexibility to increase or decrease the system's operational capability by adding or removing electronic cards. This allows TCS to be configured to meet the user's deployability or operational limitations. TCS is a software-intensive system required to be compliant with joint tactical architecture, common imagery ground/surface system, and defense information infrastructure and common operating environment.

The TCS will be integral to the US Army TUAV ground control station (GCS) and the US Navy/US Marine Corps VTUAV GCS. The USN TCS will provide varying levels of interaction across the fleet with tactical, MAE, and HAE UAVs. TCS will be the control system for all ship-based UAVs, and for USN ships without UAVs, a TCS equipped workstation may be integrated with the ship to provide the required connectivity to UAV operations.

The USAF RQ-1 Predator GCS will provide sensor and payload control, flight control, and launch and recovery capability for the Predator air vehicle. TCS will be incorporated into the Predator GCS to provide TCS direct data receipt and data dissemination to the required TCS C^4I architectures.

TCS will be interoperable with a wide range of Joint and Service C^4I systems for imagery, data dissemination, and mission planning. The TCS, however, does not contain organic communications capability. For those UAV systems that have organic communications, additional C^4I interfaces may be provided by the TCS.

The TCS consists of six sub-systems: (1) the line of sight antenna assembly; (2) the integrated data terminal; (3) the data link control module; (4) the computer; (5) the synthetic aperture radar sub-system; and (6) the workstation. Various configurations of these pieces have been used in operational exercises and technical demonstrations.

BACKGROUND INFORMATION

The Joint Requirements Oversight Council initially validated the TCS Operational Requirements Document (ORD) on February 3, 1997 (JROCM 011-97). This ORD identified the urgent need to provide a common tactical control system for the current and future family of tactical and medium altitude endurance UAVs. The JROC reviewed and revalidated the revised TCS ORD on February 3, 2000 (JROCM 010-00). The primary changes in the revised ORD were to make the control of the USAF Predator air vehicle and payload by other Service's TCS an objective vice threshold requirement.

The Navy Acquisition Executive is the Milestone Decision Authority for this joint program. The developing agency is the Navy's PMA-263, Program Executive Office for Strike Weapons and Unmanned Aviation (PEO(W)). The Army, Navy, Air Force, and Marine Corps are participating in the program. ASN(RDA) approved the Milestone II to enter EMD on February 25, 2000.

The U.S. Joint Forces Command provides joint warfighter oversight for TCS. This includes supporting test plan development, involvement in operational demonstrations, and access to the Joint Operational Test Bed System. The Joint Interoperability Test Command (JITC) has the lead responsibility for the conduct and evaluation of joint interoperability test activities and standards conformance testing.

TCS is primarily software integrated into a host UAV system. Incremental implementation of TCS during the concept exploration phase led to six releases of software called Engineering Builds (EB). Participation in warfighting exercises and demonstration using these incremental builds led to the convergence into a baseline Block 0 system. A baseline Block 1 system will be the Army TUAV TCS, and the baseline Block 2 system will be the Navy VTUAV TCS and Air Force Predator retrofit. Eventually, Block 1 and Block 2 will be merged into a Block 3 TCS interoperable with all Services' UAVs.

During EMD, four Engineering Development Units (EDU) will be delivered for formal developmental and operational testing. EDU 1 and 2 will be test assets for the sea-based and land-based configurations. EDU 3 will be the Block 1 asset for the TUAV program and EDU 4 will be a Block 2 asset for VTUAV testing.

TEST & EVALUATION ACTIVITY

No operational tests, demonstrations, or exercises were conducted with TCS inter-operating with a UAV platform this year. Many scheduled events were cancelled such as EB5 manual launch and recovery, EB6, Pioneer-TCDL demonstrations, and participation in JTFEX 00.

This office approved the TCS TEMP in November 2000, with the guidance that the operational testing of TCS should be conducted with the UAV system it supports in an operationally realistic environment. This has been problematic to define to date because there are no joint tactics, techniques, or procedures (TTPs) in place for one Service to interoperate with another Service's UAV. Each Service will conduct a system-specific IOT&E tied to their ORD. A subsequent capstone IOT&E must be developed to consist of a combined test with TUAV, Predator, and VTUAV all operated by the same TCS. Service approved TTPs must be developed prior to this test.

TEST & EVALUATION ASSESSMENT

The JITC continues to work with the TCS program office and contractor for C^4I interoperability certification. None of the TCS C^4I products are certified at this time.

USMC H-1 UPGRADES

Navy ACAT ID Program		Prime Contractor
Total Number of Systems:	280	Bell Helicopter Textron
Total Program Cost (TY$):	$9652M	
Average Unit Cost (TY$):	$10.9M	
Full-rate production:	2QFY04	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

This program combines upgrades of two USMC H-1 aircraft: the AH-1W Cobra attack helicopter and the UH-1N light utility helicopter. The common elements of the two will be identical twin engines, drive trains, a new four-bladed rotor, tail sections, and integrated digital cockpits. In addition, the AH-1 attack helicopter will gain an upgraded targeting system and the UH-1 will have an upgraded night navigation system. The upgrade will extend the life of the two H-1 models well into the 21st century. The AH-1 will contribute to ***precision engagement*** and ***full-dimensional protection***; the UH-1 will provide support for ***focused logistics***.

The upgrade of the AH-1W is referred to as the AH-1Z, and the upgrade of the UH-1N is referred to as the UH-1Y. Collectively, the AH-1Z/UH-1Y effort constitutes the USMC H-1 Upgrades Program.

BACKGROUND INFORMATION

The Marine Corps instituted the H-1 Upgrade program in 1996 by combining several lesser planned upgrades to their UH-1 utility and AH-1 attack helicopters. Prior to entry into EMD in September 1996, DOT&E approved the program's alternative LFT&E plan and USD(A&T) approved a waiver from full-up, system-level LFT&E. The AH-1Z will be tested full-up, system-level; the UH-1Y received a waiver from full-up, system-level testing. The H-1 Upgrades Operational Requirements Documents require that both helicopters be tolerant to impacts by 12.7mm rounds and have crashworthy enhancements. Additionally, the drive components of the AH-1Z should be damage-tolerant to 23mm rounds.

Prior to entry into EMD in September 1996, DOT&E approved the H-1 program's LFT&E program plan. This plan requires the AH-1Z to undergo full-up, system-level Live Fire testing. The UH-1Y received a waiver certification from full-up, system-level Live Fire testing and will be tested and evaluated in accordance with its approved alternative LFT&E plan. The alternative LFT&E alternative plan calls for component- and subsystem-level testing of critical components for each helicopter. Common components tested as part of the AH-1Z Live Fire tests will not be retested as part of the UH-1Y Live Fire testing.

TEST & EVALUATION ACTIVITY

The only OT&E activity during the year was test planning. The approved TEMP calls for the T&E program to be conducted in two phases: integrated contractor/government developmental testing called IT; and Operational Testing. Each aircraft model (AH-1Z and UH-1Y) will undergo its own individual OT and LFT test.

To provide feedback early in development, the operational testers have formed a team to monitor IT and to provide Marine maintainers to assist with aircraft maintenance and to validate maintenance documents and procedures. Concurrent with IT, the operational testers will conduct two operational assessments that will provide data to support two LRIP decisions. OT for both aircraft will be conducted prior to MS III. LFT&E of components and full-scale test articles is being conducted during the course of EMD to complement IT and OT.

Live Fire testing of critical components and subsystems continued, with five of the 17 scheduled tests now completed. During this past year, ballistic firings were conducted against the main rotor drive shaft and the 42º gearbox that drives the tail rotor. FY01 tests will include dynamic ballistic tests of the 90º gearbox located directly next to the tail rotor.

An LFT&E Integrated Product Team (IPT), which includes representatives from DOT&E, the program management activity, the Navy's Air Systems Command, and the prime contractor, has been formally established under the Test Integration Working Group. This group has implemented changes in the component test procedure to ensure that an adequate "get-home" capability is demonstrated following hits to critical components, and is identifying opportunities for a battle damage repair team to participate in the component-level tests as well as the full-up and full-up, system-level Live Fire testing. Priority will be given to those tests against H-1 components which have been redesigned (and thus require a new repair technique to be demonstrated) or lack an repair procedure. Utilization of the component tests to develop or revise repair techniques will allow an opportunity for these new techniques to be demonstrated during the full-up Live Fire tests of the UH-1Y and the full-up, system-level Live Fire tests of the AH-1Z.

TEST & EVALUATION ASSESSMENT

An Integrated Test Team (ITT) consisting of government and contractor flight test engineers and pilots will conduct the IT phase. The contractor will demonstrate safety of flight of the EMD aircraft prior to participation of government personnel in flight testing. Funding constraints continue to threaten the overall scope of testing; recent program upheaval caused by increased costs and poor performance by the avionics integration subcontractor triggered an ongoing review of the program baseline, the outcome of which is not clear at this writing. The program Test Integration Working Group, in which DOT&E participates, is actively seeking to develop an integrated T&E program that should resolve all critical technical and operational issues before production.

The H-1 Upgrade Program has a comprehensive, robust LFT&E plan which starts with component- and subsystem-level tests and culminates with full-up, system-level testing of an operating AH-1Z configured for combat. In a similar fashion, Live Fire testing of the full-up UH-1 test article will address all but the tail structure and drive train, which are common to both aircraft and will be tested on the AH-1Z. The Live Fire testing will explore various potential kill mechanisms and identify potential design flaws caused by hits from expected threats. The LFT&E program is fully integrated into the systems engineering effort and should yield a reasonable opportunity to incorporate improvements if deficiencies are identified.

V-22 OSPREY

Navy ACAT IC Program

Total Number of Systems:	459	
Total Program Cost (TY$):	$41.157MM	
Average Unit Cost (TY$):	$89.7M	
Full-rate production:	2QFY01	

Prime Contractor

Bell-Boeing Joint Venture

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The V-22 Osprey is a tilt-rotor vertical/short takeoff and landing (VSTOL), multi-mission aircraft developed to fill multi-Service combat operational requirements. The MV-22 will replace the current Marine Corps assault helicopters in the medium lift category (CH-46E and CH-53D), contributing to the ***dominant maneuver*** of the Marine landing force, as well as supporting ***focused logistics*** in the days following commencement of an amphibious operation. The Air Force requires the CV-22 to provide a long-range VTOL insertion and extraction capability and to supplement the Special Operations Forces (SOF) MC-130 aircraft in ***precision engagement***. The tilt-rotor design combines the vertical flight capabilities of a helicopter with the speed and range of a turboprop airplane and permits aerial refueling and worldwide self-deployment.

Two 6150 shaft horsepower turboshaft engines drive two 38-ft diameter, 3-bladed proprotors. The proprotors are connected to each other by interconnect shafting which maintains proprotor synchronization and provides single engine power to both proprotors in the event of engine failure. The engines and flight controls are controlled by a triply redundant digital fly-by-wire system.

The airframe is constructed primarily of graphite-reinforced epoxy composite material. The composite structure is intended to provide improved strength to weight ratio, corrosion resistance, and damage tolerance compared to typical metal construction. Battle damage tolerance is built into the aircraft by means of composite construction and redundant/separated flight control, electric and hydraulic systems. An integrated electronic warfare defensive suite including a radar warning receiver, a missile warning set, and a countermeasures dispensing system will be installed.

BACKGROUND INFORMATION

The V-22 is being developed to meet the provisions of the 19 May 99 Joint Multi-Mission Vertical Lift Aircraft (JMVX) Operational Requirements Document (JORD) for an advanced vertical lift aircraft. The JORD calls for an aircraft that will provide the Marine Corps and Air Force with the capability to conduct assault support and long-range, high-speed missions requiring vertical takeoff and landing capabilities.

During Full Scale Development (FSD) from 1986 to 1992, the V-22 T&E program principally concentrated on engineering and integration testing performed by the contractor. Three periods of formal development testing by Naval Air Warfare Center-Aircraft Division, Patuxent River, MD, plus OTA participation in integrated test team activities at Patuxent River, provided early insight into the development effort. After transition to EMD in 1992, an integrated contractor/government test team conducted all tests until OT-IIA in 1994. Starting with OT-IIA in 1994, a total of five periods of OT&E have been conducted.

The first three periods of OT&E used test aircraft from the earlier FSD program, with only limited flight time available, and extensive restrictions on allowable flight maneuvers. The main thrust of these OT&E periods was ground tests and simulation. OT-IID in 1998 was conducted using EMD aircraft numbers 9 and 10, the final two aircraft delivered under the EMD program. OT-IID consisted of 142.6 flight hours conducting operationally realistic missions at four locations: NAS Patuxent River, MD; New River MCAS, NC; Camp Dawson AAF, WV; and Eglin AFB, FL. At the conclusion of OT-IID, the MV-22 was found to be potentially operationally effective and potentially operationally suitable, although unrealistic maintenance procedures and contractor involvement skewed the reliability and maintainability data.

The ballistic design requirements specify "not-to-exceed" vulnerable areas for the following threats: 7.62mm API, 12.7mm API, 14.5mm API, and 23mm API. Hits could occur at either hover condition or during a 2-g maneuver. Following a hit, the aircraft must be able to complete a 30-minute flight and land vertically.

A waiver request from full-up, system-level Live Fire testing for the V-22 was supported by DOT&E and certified by the Secretary of Defense on April 25, 1997. An alternative LFT&E plan, approved by DOT&E prior to submittal of the waiver request, included a comprehensive series of ballistic tests of critical components, major assemblies, and aircraft structures. The V-22 alternative LFT&E plan was a balanced approach, which started early in the design process and utilized trade-studies, analytical and prediction tools, and realistic Live Fire testing. Live Fire testing was viewed as an integral part of the design process, not merely as a method of design verification. With this approach, problems could be identified early, allowing timely fixes that could be retested later in the program. The alternative LFT&E plan recognized that modeling and simulation alone is not sufficient to predict the vulnerability of a component or to identify potential design changes. A continuous process of design refinements has been an integral part of the system engineering effort since the start of Live Fire testing, and several design changes have been made based on the test results.

The V-22 Live Fire test program consisted of 582 shots over 16 years. Ballistic testing of the V-22 design began in 1984. From 1984-1990, a total of 51 ballistic test firings were conducted against pre-FSD components and subsystems. An additional 87 test firings against the FSD design were completed from 1994-2000. The EMD demonstration test series consisted on 444 test firings from 1996-2000 to demonstrate the final production aircraft design.

TEST & EVALUATION ACTIVITY

OT-IIE (OPEVAL) of the MV-22, began on November 2, 1999, and finished on July 21, 2000, accomplishing 804 flight hours in 522 sorties. OPEVAL was conducted with five MV-22 LRIP aircraft, aircraft numbers 11 through 15, aboard four Navy ships and at nine locations ashore.

The last remaining V-22 Live Fire test series were conducted in FY00. The following ballistic test series were completed: pylon conversion spindle, swashplate actuator, proprotor grip, proprotor yoke, aircraft structure, sponson hardening, aft sponson fire, empennage attachment hardware, and wing attachment hardware. The last four test series were accomplished by firing at a production-representative EMD aircraft (the EMD static test article).

DOT&E completed our evaluation of test adequacy, operational effectiveness, suitability, and survivability and submitted the required report to the Secretary of Defense and congressional defense committees in time to support the Milestone III decision by the Navy in November 2000.

DOT&E oversight of FOT&E will continue to verify correction of deficiencies and to ensure that deferred OT&E events are finished. Since additional design changes and improvements are currently being considered, our LFT&E oversight activities on the V-22 will continue as well. These changes include the addition of a self-defense weapon and addition fire suppression protection in the sponsons.

TEST & EVALUATION ASSESSMENT

Testing was adequate to determine the MV-22's operational effectiveness, operational suitability, and survivability. However, additional testing is needed to verify correction of deficiencies, the effectiveness and suitability of waived items, and to investigate the vortex ring state. The MV-22 is operationally effective but not operationally suitable. Results from OT-IIE (OPEVAL) indicate that the V-22 will provide major range, speed, and payload improvements to meet Marine Corps and Special Operations Forces (SOF) requirements. The V-22 offers significant maneuverability and handling advantages as compared to conventional helicopters; e.g., rapid deceleration upon arrival at a landing zone and rapid acceleration during departure. When tactics are fully developed, these capabilities should provide substantive mission accomplishment and survivability advantages. In addition, OPEVAL results indicated that with modified operational procedures, at least some required tasks could be performed despite the downwash experienced in the rotary mode, which had been an issue of concern in previous OT&E. The MV-22 meets all the key performance parameters specified in the Joint Operational Requirements Document.

Operational testing of the MV-22 did not demonstrate that the MV-22 as configured and tested during OPEVAL is operationally suitable. The MV-22 demonstrated marginal mission reliability, excessive maintenance manpower and logistic support requirements and inadequate availability, interoperability, human factors, documentation, and diagnostics capabilities. In the latter half of OPEVAL, the trends on some key measures of suitability were positive, suggesting that the aircraft has the potential to eventually meet its suitability requirements. Nonetheless, taken as a whole or considering only its improved suitability data from the second half of OPEVAL, the MV-22 failed to meet several important JORD established thresholds. Moreover, the demonstrated results for MV-22 mission reliability, maintainability, and availability were less favorable than the same measures from the fielded CH-46 fleet. The OPEVAL results also failed to confirm the reliability and diagnostic improvements postulated before the test.

Operational testing has shown that the MV-22, as configured and tested, did not achieve the established suitability thresholds for:

- Mean Flight Hours Between Aborts
- Mean Time Between Failure
- Maintenance Man-Hours per Flying Hour (objective only)
- Mean Flight Hours between Unscheduled Maintenance
- Mission-Capable Rate
- Full Mission Capable Rate
- False Alarm Rate

The MV-22, as configured and tested in OPEVAL, did achieve the thresholds for:

- Fault Detection
- Fault Identification
- Mean Turn Around Time
- Mean Corrective Maintenance Time

OPEVAL results for Mission Reliability were marginal, but met the JORD requirement. Additionally, the MTBF and False Alarm measures did not attain the improvement ("growth") curves projected by the V-22 program office at the initiation of OPEVAL.

The communications capabilities in the MV-22 do not provide needed interoperability with command and control elements and other forces. Further development and testing is required.

The aircraft did not have sufficient heating or cooling capability to maintain acceptable cockpit and cabin temperatures during operations at extreme temperatures ranging from 117 degrees F in desert operations to cruising at 18,000 ft. altitude where the outside air temperature was 23 degrees F.

Documentation was deficient during OPEVAL. Specifically, many aspects of both the NATOPS and of the Integrated Electronic Technical Manual were incomplete and inaccurate, contributing to the extra maintenance workload.

Although the Fault Detection rate and the Fault Identification rate exceeded requirements, the associated False Alarm rate was so high as to make the entire automated Diagnostics capability of little or no value.

The effectiveness of the V-22's vulnerability reduction features was demonstrated during the LFT&E program. Also, the following vulnerability reduction features were developed or integrated into the design as a direct result of LFT&E: redundant jam-proof actuators; run-dry gear boxes; improved composite wing structure and fuel tanks; dual, tandem swashplate actuators; damage-tolerant ballscrew conversion actuators; dry bay fire protection; self-sealing fuel tanks; and suction fuel system.

Early ballistic tests against the FSD aircraft identified a potentially serious cracking problem following a hit into the composite sponson fuel tank structure. The damage was significantly greater than expected, and was accompanied by fires under the fuselage floor and within the cargo/passenger area of the fuselage. The sponson structure was redesigned using a different epoxy resin as well as a revised graphite fiber laydown process and retested. The additional tests demonstrated that the cracking was significantly reduced, there were no fires, and was within the repair limits typically used for composite structures.

An aircraft battle damage repair (ABDR) team comprised of Navy depot personnel and USAF SOF maintenance NCOs evaluated the damage following each firing into the Static Test article. Their assessment found that the improved sponson design was within acceptable limits for field expedient repairs at the organizational level. A concern remains in the capability to repair damage to the passenger cabin walls. This relatively thin structure was damaged in nearly all of the sponson test shots with the ORD threshold threat. These walls are critical, load-bearing members of the aircraft structure. Live Fire testing demonstrated that the aircraft would be capable of returning to base following a hit to the sponsons. Damage to the cabin walls requires an engineering assessment of the damage and repair, by regulation. Therefore, repair of damage to the cabin wall cannot be accomplished at the organizational level because the required engineering support is not available at this level of maintenance. This issue will be addressed during a second phase of the ABDR program. However, this additional effort remains unfunded.

A new fire suppression technology, gas generator fire suppressors, was developed and demonstrated during the LFT&E program. These suppressors are a relatively small, lightweight, cost-effective fire suppression alternative, which utilize a non-ozone depleting compound and provide fire protection during peacetime operations as well as combat. This new technology, which was installed in the wings of the flight test aircraft, already is credited with extinguishing a fire caused by a mechanical failure in an aircraft before it caused serious structural damage, thereby preventing the loss of a test aircraft.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

The loss of one of the OPEVAL aircraft in a fatal mishap was attributed to a phenomenon known as Vortex Ring State. It is essential that the V-22 technical and operational community understand the phenomenon of vortex ring state as it applies to the V-22. Successful mapping of this region must be accomplished via a program of flight test, wind tunnel testing, and modeling and simulation. Key elements of such needed testing are:

- exploring the flight envelope of the actual aircraft under equilibrium conditions to map the boundary of the effect,

- exploring the flight envelope of the actual aircraft under transient conditions of power and flight control inputs to determine the effect of such transients, and
- use of scale-model rotors in wind tunnels to characterize the airflow field surrounding the rotor system near the boundary of the phenomenon.

Additional testing under realistic sustained operational conditions must be performed to ensure that the mission reliability, maintainability, logistics burden, availability, interoperability, documentation, and diagnostic shortfalls reflected in OPEVAL are corrected. Unless corrected, these suitability shortfalls will impose an unacceptable burden (cost, manpower, mission reliability, and operational availability) on the operational fleet.

Waived requirements from the JORD should be incorporated at the earliest practical time. Follow-on operational testing should address the effect of these waived items and capabilities on overall operational effectiveness and suitability.

Several design changes were made as a direct result of the Live Fire test program. Development and demonstration of some of these vulnerability reduction features, such as those found in the sponsons and wing structure, required several iterations (test-fix-test) to achieve the desired characteristics.

Vulnerability modeling of ballistic events is still inadequate to predict aircraft and crew vulnerability and to identify potential design changes to reduce vulnerability to hostile fire. For instance, the existing models were not able to verify the actual capability of the vulnerability reduction features integrated into the V-22's design. These models require additional improvements, particularly those addressing warhead fuzing, fire initiation, explosions, and the performance of various fire suppression alternatives.

The V-22 program is developing a new, structural-analysis-based ABDR procedure that shows exceptional promise. This procedure provides for an aircraft damage assessment and triage to be carried out when a threat damaged aircraft returns to base. Commanders can then determine whether a damaged aircraft can continue to be used to support combat operations and under what load/speed/range restrictions or whether repair procedures or evacuation of the aircraft are required. In the past, when there was a doubt, a damaged aircraft would have been sidelined until depot repairs were made and certified. The ABDR effort has been severely constrained by a lack of funding. The Navy must ensure adequate funds are provided to complete the ABDR program for the V-22.

VIRGINIA (SSN 774) CLASS ATTACK SUBMARINE

Navy ACAT ID Program		**Prime Contractor**
Total Number of Systems:	30	General Dynamics Electric Boat Division
Total Program Cost (TY$):	$65,151M	Newport News Shipbuilding
Average Unit Cost (TY$):	$1,995M	Lockheed Martin Federal Systems (Combat System)
Full-rate production:	1QFY07	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

VIRGINIA will replace the aging fleet of LOS ANGELES (SSN 688) Class submarines and is intended to maintain the U.S. technological lead in undersea warfare well into the 21st century. VIRGINIA is intended to be a submarine comparable in most respects to its immediate predecessor, the SEAWOLF, but in a more affordable configuration. It is designed to rapidly deploy to militarily important hostile ocean areas and deny their use to the enemy, clear the way for strikes by other friendly forces, and engage and destroy enemy submarines, surface forces and land targets, supporting ***dominant maneuver*** as well as ***full-dimensional protection*** for forces afloat. VIRGINIA will have a broad range of missions packaged in a quiet, heavily armed, shock resistant, survivable submarine. These include Covert Strike Warfare, Anti-Submarine Warfare, Covert Intelligence Collection/Surveillance, Covert Indication and Warning and Electronic Warfare, Anti-Surface Ship Warfare, Special Warfare, Covert Mine Warfare, and Battle Group Support. VIRGINIA includes systems that incorporate technological advancements enabling greater ship quieting, improved acoustic sensors (with potential for subsequent growth), a flexible weapon load and ability to more quietly launch weapons, an advanced nuclear reactor, improved propulsion machinery, an advanced propulsor, improved ship control, and enhanced survivability. VIRGINIA will use advanced technology and commercial off-the-shelf (COTS) equipment to reduce acquisition and life-cycle costs while retaining mission effectiveness.

VIRGINIA is required to be capable of targeting, controlling and launching MK 48 ADCAP torpedoes, mines, and Tomahawk missiles from anywhere in the ocean. Its sonar capability is expected to be similar to SEAWOLF's, and its electronic support suite and combat control system represent improvements over legacy systems. The external communications system is required to be an improvement over SEAWOLF and legacy systems, providing full, high data rate interoperability with U.S. and allied forces. These characteristics provide intelligence and strike capabilities to support the Joint Force Commander in ***precision engagement***. VIRGINIA is required to maintain a level of stealth equivalent to the requirements of the SEAWOLF (SSN 21) class submarines.

More details are provided in the classified version of this report.

BACKGROUND INFORMATION

The Milestone I DAB approved VIRGINIA to enter Phase I in August 1994. For Milestone II, a very aggressive and thorough EOA of VIRGINIA was conducted in accordance with a DOT&E approved test plan, concluding that VIRGINIA was potentially operationally effective. More details are provided in the classified version of this report. The Program Office and Navy sponsor fully supported this EOA and generally agreed with the findings.

DOT&E recommended and the Secretary of Defense approved a statutorily allowed waiver to full-up, system-level live fire testing of VIRGINIA because such tests were considered unreasonably expensive and impractical. DOT&E approved the alternative LFT&E plan submitted in lieu of full-up, system-level testing in June 1995. This plan includes shock qualification tests and analysis of components, surrogate underwater shock tests, a Total Ship Survivability Trial (TSST), a Ship Shock Test, as well as a series of vulnerability assessments. The Milestone II DAB approved VIRGINIA to enter Phase II on June 30, 1995.

An OA, which supported a DAB Program Review in FY97, concluded that the VIRGINIA design should lead to a potentially operationally effective submarine. The OA identified three high and six moderate risk areas. More details are provided in the classified version of this report. Many of the issues identified during the FY97 OA were the results of programmatic decisions to scope back efforts or eliminated capabilities factored into the original estimates of the VIRGINIA performance baseline.

On September 30, 1998, the Navy and Electric Boat signed the construction contract for the first four NSSN hulls. The $4.2 billion contract has Electric Boat as the prime contractor and Newport News Shipbuilding as a major subcontractor. On October 2, 1998, the first hull of the NSSN class officially became the USS VIRGINIA (SSN 774).

The Submarine Combat Systems program office is conducting VIRGINIA sonar development. Its leading sonar program, known as AN/BQQ-10 Acoustic Rapid COTS Insertion (A-RCI), uses COTS technology to upgrade submarine sonars. Current upgrades are for the SSN 688 class submarines, and will later include TRIDENT SSBNs, SEAWOLF, and VIRGINIA. The SSN 688 series consists of four phases: Phase I upgraded the towed array narrow band and spatial vernier processing on two 688 class submarines which have since been upgraded to Phase II; Phase II significantly upgrades all aspects of towed array processing; Phase III upgrades spherical array and hull array processing and an enhanced onboard training capability; and Phase IV upgrades high frequency sonar processing. Phase II is currently being operated on many SSN 688 class submarines. In response to fleet demands, a planned software/hardware upgrade (Advanced Processing Build (APB)) for the Phase II sonar known as Phase II+ was introduced five months in advance of schedule. Early shipboard installation of Phases III and IV occurred in late FY00, and development continues. After Phases III and IV operational tests are completed in FY01, the A-RCI program will continue to upgrade its sonars through the APB sequence, which is a periodic (approximately annual) software and/or hardware upgrade plan. The AN/BQQ-10 series sonar is planned to progress to a common COTS architecture for all U.S. submarine sonars by 2005-2007.

TEST & EVALUATION ACTIVITY

As of December 2000, DOT&E was awaiting receipt of Revision C to the TEMP, which was in final Navy approval routing. This TEMP revision includes a move of the Full Ship Shock Test and Total Ship Survivability Trial from Hull 1 to Hull 2, which DOT&E agreed to based on the Navy's input that this move would improve overall scheduling stability without impacting the Milestone III decision date

In May 2000, COMOPTEVFOR issued an Interim Operational Assessment Report on VIRGINIA.

In May 2000, the SSN 688 submarine variant of the AN/BLQ-10 Electronics Support Measures (ESM) system passed its Operational Evaluation.

Extensive early integration testing of the VIRGINIA Non-propulsion Electronic System (NPES) occurred throughout the year. NPES is the name given to the 26 sub-systems outside the propulsion plant, and the local area network that ties these systems together on an asynchronous transfer modem (ATM), fiber optic computer network.

Technical testing to improve the acoustic performance of VIRGINIA propulsor development continued throughout the year. More details are provided in the classified version of this report.

The Naval Security Group assisted COMOPTEVFOR in evaluating the vulnerability of VIRGINIA's combat and ship control systems local area network. This assessment included looks at outside attack, internal attack, and inadvertent error. The initial evaluation was included in COMOPTEVFOR's Interim Operational Assessment Report. Evaluation will continue in FY01.

A-RCI/BQQ-10 Activity. (1) A-RCI Phase II+ was installed on an SSN-688 class submarine in April 2000. From April to June 2000 fleet training teams and the developer conducted installation testing, software development, system performance observation, and crew training. With no operational test of the Phase II+ sonar, this submarine then deployed. (2) An operational assessment of A-RCI Phase II+ was scheduled to occur in the Pacific in September 2000, but was not performed due to platform problems unrelated to the sonar. The test was reschedule for January 2001. (3) Developmental testing of A-RCI Phases III and IV occurred in the Atlantic during September and November 2000. (4) Technical evaluation of A-RCI Phase IV occurred in the Pacific in October and November 2000. More details are provided in the classified version of this report.

Other testing included: (1) Lightweight Wide Aperture Array sonar performance and environmental testing; (2) TB-29A Risk Reduction Array self-noise, telemetry, and durability testing; (3)

Weapon Stowage and Handling System (WSHS) hardware and software integration testing; (4) AN/BLQ-10 Photonics Mast engineering developmental model at-sea testing; (5) UNDEX component shock testing; (6) Reverse Osmosis Unit prototype at-sea testing; (7) High Speed Emergency Diesel Generator electrical load testing (unsatisfactory); and (8) Integrated Low Pressure Electrolyzer endurance testing.

In FY 99, DOT&E reviewed and twice commented on the Navy's September 1998 Update I of the VIRGINIA detail design vulnerability assessment report (VAR) and the Navy's actions to resolve DOT&E's VAR comments. In FY00, the Navy continued its vulnerability assessment work to support the next VAR Update, which is due in June 2001. DOT&E continued to participate in VIRGINIA LFT&E working group meetings to reach resolution of VAR comments, and provided insight as well as oversight on Navy planning for future LFT&E activities. DOT&E also witnessed component shock qualification tests, and reviewed with the Navy the results of Live Fire component and surrogate tests including extensive underwater shock tests of the A/B-1 test vehicle, completed in 1999.

The Navy announced its intention to develop electric drive in future VIRGINIA Class submarines, starting in about 2010. DOT&E will evaluate the potential impact on the survivability of this major product improvement program.

TEST & EVALUATION ASSESSMENT

Due to post-delivery schedule conflicts with other high priority tests required for ship safety, susceptibility, and weapons systems performance, DOT&E agreed with a Navy proposal to move the Full Ship Shock Test (FSST) to Hull 2, contingent on the Navy's agreement to not seek any further moves of the FSST to a later hull. This move also requires revision of the TEMP Life Fire Test & Evaluation Strategy, which DOT&E has tasked the Navy to provide in FY01.

COMOPTEVFOR's Interim Early Operational Assessment (EOA) recomputed Virginia Anti-submarine Warfare (ASW) performance predictions using Naval Undersea Warfare Center (NUWC), Newport, computer models, and by changing several key inputs, based on more up-to-date information than was available in 1994. COMOPTEVFOR's intent was to assess VIRGINIA against the most challenging foreseen future threats. The revised inputs included upgrading the nuclear attack submarine Threat of Record, upgrading the threat diesel submarine, updating threat and own-ship tactics, refining VIRGINIA performance characteristics, and changing to NUWC's more recent and sophisticated ocean environment computer model. Results are found in the classified version of this report. In addition, the Interim OA Report cited the NPES (slow software development), the radio room (equipment space to support functionality), and the TB-29A towed array (interoperability with the combat system) as medium to high risks. The report also cited inadequate ship manning for information systems technicians and immature concepts of operations for the photonics mast as current concerns. The report also cited other concerns that are discussed in the classified version of this report. DOT&E agrees with COMOPTEVFOR's assessment, but notes that added emphases are needed in at least two more areas, one of which is discussed in the classified version of this report. The other area needing further examination is TB-29 series towed array reliability, which has been an historical problem. COMOPTEVFOR has indicated that the next and final EOA Report, due in late FY01, will include these additional two areas.

A-RCI operational testing quality continued to be sub-par. To date, Submarine Force training teams have performed much of the A-RCI sonar assessment, with feedback going directly to Submarine Force leadership and not being provided to the operational test community. This practice has ignored the approved Chief of Naval Operations channel for conducting operational tests and reporting results, although about 25 submarines are now using A-RCI sonars. More details are provided in the classified version of this report.

The Navy has evaluated six damage scenarios for the detail design VAR using linear extrapolation from physics-based design-level shock analyses in local environments to 10 percent above the design level. The assessment at this level of shock intensity resulted in very limited damage and few lessons learned. The Navy is proposing a "Meaningful Drill Concept" for the post-delivery Total Ship Survivability Trial (TSST) with damage scenarios that are to be tied back to the six shot lines. However, the damage scenarios for these shot lines have not been developed to reflect the effects of secondary damage (e.g., fire, flooding, hydraulic leak, loss of control circuits, etc.). Another concern is how or to what degree the Navy will simulate realistic propulsion plant damage in the TSST scenarios. DOT&E is continuing to work with the Navy to resolve these issues.

There are other LFT&E concerns. (1) The Navy has not described its approach for Verification, Validation, and Accreditation (VV&A) of LFT&E computer models. (2) The Navy has not described how it will extrapolate Ship Shock Test results to higher shock intensity levels for use in the assessment of VIRGINIA's vulnerability to underwater shock. (3) The Navy has not shown how (or if) it will assess VIRGINIA's ability to surface after exposure to an underwater burst at the hull integrity shock factor level. (4) Because of funding shortfalls, the Weapons Handling Module (WHM) shock test on A/B-1 has been moved from FY01 to FY03. Funding shortfalls may also result in revised and potentially less stringent shock qualifications of the WHM and other components that were originally planned for testing on A/B-1. These risks for later deficiency identification and lower standards concern DOT&E, who continues to work with the Navy to reach understandings and resolve differences.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

The Navy appears to be initially successful in developing usable Commercial-Off-the-Shelf computer systems for submarine sonars in the A-RCI program. The extent of this success, however, has yet to be independently assessed, and history has shown that ample, robust, and independent operational testing is essential for ultimate success. Short-changing TEMP agreed-to operational testing periods, often cited as necessary to maintain fleet operating tempo, needs to be less frequent, and a higher priority needs to be given to operational testing. The A-RCI Phase III Operational Evaluation, scheduled for March 2001, is an opportunity to conduct meaningful operational testing, and needs to be completed as planned.

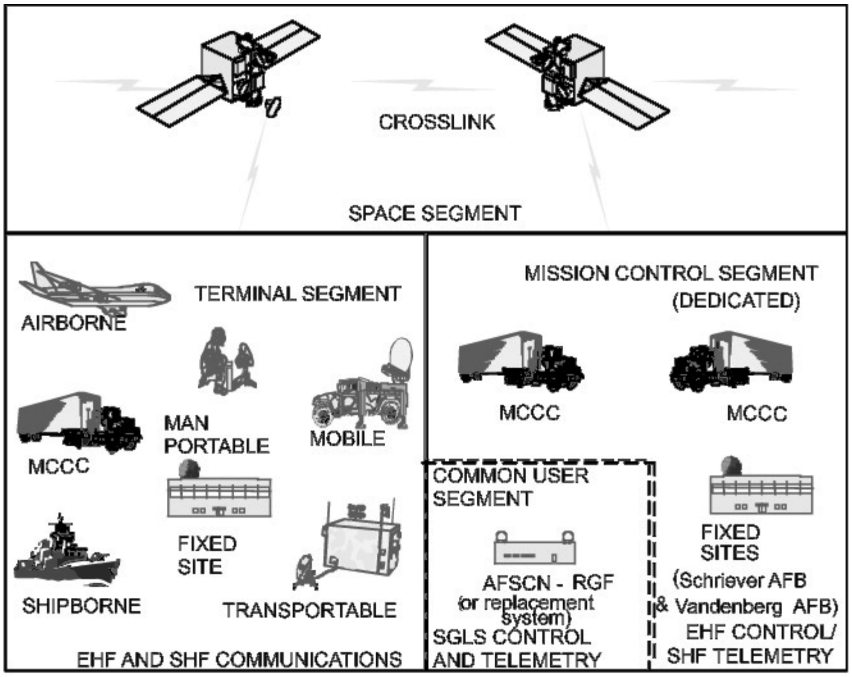
The Navy needs to develop realistic TSST scenarios that stress the submarine and include the effects of secondary damage. DOT&E will work with the Navy to ensure that scenarios developed for TSST are appropriate, include the effects of secondary damage, and meet LFT&E statutory requirements.

The Navy's recent trend of deleting funding from previously agreed-to ship shock testing, as evidenced by USS SEAWOLF and DDG-51 Flight Two, needs to be stopped, and Congressional support is needed to make this happen.

PART V

AIR FORCE PROGRAMS

ADVANCED EXTREMELY HIGH FREQUENCY (AEHF) SATELLITE COMMUNICATIONS SYSTEM



Air Force ACAT ID Program		**Prime Contractor**
Total Number of Satellites:	5	Lockheed Martin
Total Program Cost (TY$):	$4.2B	
Full-rate production:	N/A	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Advanced Extremely High Frequency (AEHF) satellite communications (SATCOM) system provides secure, survivable communications to U.S. warfighters during all levels of conflict, and is the protected backbone of DoD's Military Satellite Communications architecture. Its unique capabilities will enable our forces to maintain ***information superiority*** throughout all levels of conflict, enhancing ***full-dimensional protection*** and ensuring that warfighters retain freedom of action through continuous, secure communication.

The AEHF system will greatly increase both the available single user data rate and total satellite capacity while maintaining the essential features of Milstar II, namely nuclear survivability, robust anti-jam performance, Low Probability of Intercept/Low Probability of Detection capabilities, and worldwide access/interoperability. The AEHF system will provide essential, survivable, anti-jam communications service for the National Command Authorities (NCA) and Commander-in-Chiefs to command and control strategic and tactical forces across the spectrum of mission areas in all levels of conflict, including nuclear war. Strategic forces and theater missile defense forces will use the AEHF system to transmit Integrated Tactical Warning/Attack Assessment information to correlation centers and forward users such as NCA.

BACKGROUND INFORMATION

The Advanced EHF system is intended to replace the current MILSTAR system when it reaches end of life. The first MILSTAR satellite was launched in 1994 onboard a Titan IV rocket. The second satellite was launched in 1996. MILSTAR Flight 3, the first medium data rate satellite, was launched on April 30, 1999. However, the mission was declared a failure when a problem with the Centaur upper stage placed the satellite in an operationally useless orbit. MILSTAR Flights 4, 5, and 6 will be launched in FY01 and FY02.

In lieu of an additional MILSTAR satellite to replace Flight 3, the first flight of the Advanced EHF satellite program (Pathfinder) will be launched on an accelerated schedule and programmed to operate initially as a MILSTAR II satellite. The second flight will then be launched as a fully capable Advanced EHF satellite. After it is operational, Pathfinder (Flight 1) will be re-programmed as an Advanced EHF satellite. The program underwent a major Defense Acquisition Executive review, with a significant change to the acquisition strategy. In this review, approval was granted in May 2000 to accelerate the program, end the competition, and substitute a sole source acquisition combining the two competing teams into one National Team.

The AEHF program uses a streamlined approach to design, build, launch and support a constellation of protected communications satellites in geosynchronous orbit. The first phase, the Advanced EHF Technology Program, is complete, and the second phase, the Engineering Model program, was completed at the end of FY00. The system-level program was initiated with a System Definition phase. This phase is followed by an EMD/Production phase for the design and production of five satellites and associated Mission Control Segment upgrades. The System Definition phase began in October 1999 as a competitive phase with two competing contractor teams tasked to analyze the requirements and develop system designs. This phase includes System Requirements Reviews and System Design Reviews. The EMD/Production award to the National Team is planned for March 2001. The first launch (Pathfinder) is scheduled for 1QFY05, the second launch for 1QFY07, the third launch nine months later, and the last two on six-month centers. The last satellite will be an on-orbit spare.

TEST & EVALUATION ACTIVITY

OT&E will evaluate whether or not the entire system, including equipment, personnel, procedures, training, and logistics support is effective and suitable based on the operational requirements. The Multi-Service Operational Test and Evaluation (MOT&E) program will commence after the launch of Flight 2, which will be the first satellite operating in the Advanced EHF mode. It will consist of mission testing using service terminals on operational communications networks, testing of overall mission control capabilities, assessment of system threat survivability, and evaluation of system suitability. The test will exercise satellite-to-satellite cross-links to evaluate theater-to-theater communications, network control, satellite control and interoperability. Activities will include: monitoring key DT&E events, combined DT/OT test events, updating ongoing simulation efforts with DT&E results to provide assessments not possible directly through testing, observation of voice and teletype traffic on operational networks, and dedicated MOT&E.

The initial Operational Assessment Review will be conducted using data from the Engineering Model and Technology Programs. In addition, an OA will look at the results of the DT/OT performed on the Pathfinder satellite to verify its full capability to function as a Milstar II Medium Data Rate (MDR) satellite.

TEST & EVALUATION ASSESSMENT

The Engineering Model of TRW's AEHF satellite digital processor was tested in 4QFY00 at the MIT Lincoln Laboratory SATCOM test facilities. Basic functionality of the processor concept and the feasibility of Gaussian Minimum Shift Keying modulation were demonstrated. Problem areas were identified which have helped the Program Office to characterize the areas of highest technical risk. The Program Office will follow the resolution of these problems.

RECOMMENDATIONS

This is an ambitious program due to the objective of accelerating the launch of the first satellite while maintaining a fixed-price contract development of an advanced system. The nature of the contract and the combined Milestone II/III require the entire test community to adequately define the overall strategy and master test plan very early in the program.

- It is imperative that the OA, based on DT/OT, thoroughly verify the backward compatibility and full MDR functionality of the Pathfinder satellite. This one-of-a-kind satellite will fill a critical gap in our secure communication network for at least two years.

- It is imperative that the Milestone II/III TEMP contain sufficient detail in the Measures of Effectiveness and MOT&E plan to fully define the level of effort and resources required by all participants.

AIM-120 AMRAAM

Air Force ACAT IC Program		Prime Contractor
Total Number of Systems:	10,917 (USAF & USN only)	Raytheon
Total Program Cost (TY$):	$10,399M	
Average Unit Cost (TY$):	$953K	
Full-rate production:	3QFY94	
SEP Production	3QFY92	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

AIM-120 is an all weather, radar guided, air-to-air missile with launch-and-leave capability in both the beyond-visual-range and within-visual-range arenas, enabling a single aircraft to simultaneously engage multiple targets with multiple missiles. The U.S. Air Force and Navy, as well as several foreign military forces use AIM-120. Currently employed by the F-15C, F-15E, F-16, and F/A-18C/D, AIM-120 will also be employed by the F/A-18E/F, F-22, and the Joint Strike Fighter.

The AIM-120B missile resulted from the Advanced Medium Range Air-to-Air Missile (AMRAAM) Producibility Enhancement Program. Major improvements in the missile included a new digital processor, erasable programmable read-only memory, and five electronic unit hardware chassis upgrades. AIM-120B is currently in production for foreign military sales only.

The AIM-120C was developed with clipped missile's wings and fins to reduce its box size from 17.4 to 12.5 inches. This allowed for increased internal carriage loadout in the F-22. Block change lethality improvements are being incorporated into the missile from Lot 8 and beyond, culminating in a new warhead and lengthened rocket motor in Lot 12. All current U.S. deliveries are of the AIM-120C configuration.

The AMRAAM P^3I Phase 3 development program is underway. The Phase 3 missile will include new guidance section hardware and software. The antenna, receiver, and signal processing portions of the system are being upgraded to handle the requirements to counter new threats, and will be compressed to create room for future growth. Some existing software will be re-hosted to a new Higher Order Language (C++), some existing software will be re-hosted and modified to function with the new hardware, and some additional software algorithms are being written to react to the new Phase 3 threats.

AIM-120 contributes to ***Joint Vision 2020*** by providing the warfighter with a ***precision engagement*** weapon.

BACKGROUND INFORMATION

The AMRAAM program entered FSD in September 1982. The DAB approved LRIP in June 1987; authorized continued LRIP in May 1991; and entered full-rate production (Milestone III) in April 1992. The Air Force declared AMRAAM IOC with the F-15 in September 1991, and with the F-16 in January 1992. The Navy declared AMRAAM IOC in October 1993.

FOT&E(1) was completed in May 1993. FOT&E(2) started in May 1993 and completed in December 1995. This phase of testing included the launch of 40 missiles from 12 shot profiles under various test conditions and continued the captive-carry reliability program (CCRP) testing on the F-16. Missiles from production Lots 4 through 8, including AIM-120A and AIM-120B missiles, were tested on F-15 and F-16 aircraft. Twenty-four of the live launches were missiles from CCRP inventory. The live shots were designed to evaluate missile end game performance against advanced ECM threats and warhead lethality in more challenging end game scenarios. The final FOT&E(2) live launch test event occurred in December 1995.

An updated TEMP and Test Plan to define FOT&E(3) activities was approved in 1996. FOT&E(3) emphasizes testing of lethality improvements incorporated in missiles from Lot 8 and higher, culminating with the new warhead in Lot 11 and rocket motor in Lot 12. The 1996 TEMP included an LFT&E characterization of the new contact fuze and testing of the new warhead against bomber components, as requested by DOT&E. The TEMP approval letter also stated that DOT&E would submit an LFT&E report to Congress at completion of FOT&E(3).

FOT&E(3) is an ongoing joint Air Force and Navy evaluation divided into two phases: 3A and 3B. The first phase, designated FOT&E(3A), evaluated Lots 8 through 10 hardware and software tapes 5 and 7. This test phase was completed in August 1999 and included 26 live launches and multiple AMRAAM Captive Equipment missions, along with a 3,712-hour CCRP. The second phase, FOT&E(3B), started planning in October 2000 and incorporates four concepts: (1) lot verification live launches; (2) periodic AIM-120 software validation and regression live launches; (3) captive carry testing, suitability analysis, and live launches of projected hardware modification; and (4) AMRAAM captive equipment missions and computer simulations to further validate/evaluate missile capabilities/performance based on field user inquiries.

LFT&E was conducted using arena tests for AMRAAM Pre-Planned Product Improvement (P^3I) warhead against a suite of gray and threat targets. DOT&E participated and provided oversight for the first arena test against a cruise missile and a bomber section on April 7, 1998. Pre-test predictions were provided to DOT&E after the test was executed. The second arena test, against two foreign fighter targets, was completed in October 1998. A third arena test against the same foreign fighter targets was conducted in April 1999.

The TEMP has again been updated to outline a comprehensive developmental and operational test and evaluation effort for the AMRAAM (P^3I) Phase 3 Program. The updated TEMP was put into the coordination/approval process in October 2000. This document outlines extensive OT involvement in the contractor's modeling and simulation validation processes and also describes plans for combined developmental/operational testing of two software tape upgrades: Tape 7D High Off-Boresight (HOBS) for AIM-120C and Tape 5 Rev 4 for AIM-120B.

TEST & EVALUATION ACTIVITY

FOT&E(3B) planning started in October 2000 and incorporates four concepts: (1) lot verification live launches; (2) periodic AIM-120 software validation and regression live launches; (3) captive carry testing, suitability analysis, and live launches of projected hardware modifications; and (4) AMRAAM captive equipment missions and computer simulations to further validate/evaluate missile capabilities/performance based on field user inquiries. The live launch program will be conducted at Eglin Gulf Test Range, FL, White Sands Missile Range, NM, and Naval Air Warfare Center Weapons Division, CA, and consists of missiles from Lots 12 and 13 and five Captive Carry Reliability Vehicles (CCRVs) from Lot 8. A CCRP will be conducted by COMOPTEVFOR during FOT&E(3B) to establish a baseline for the F/A-18E/F and also to test the latest version of the AMRAAM aboard ship. These CCRVs will be re-configured and fired to further validate missile reliability and performance. In addition, the HOBS capability to the AIM-120C will be evaluated as will Tape 5 Rev 4 for the AIM-120B missile.

The P^3I Phase 3 missile is scheduled to begin production in Lot 16 (FY04). This missile will incorporate new seeker and guidance sections as well as Operational Flight Program software written in a new language. A P^3I Phase 3 Total System Performance Responsibility contract was signed with Raytheon Systems Company this fiscal year. Raytheon plans eight DT&E launches (for which they will define the test scenarios), and no captive carry reliability program to demonstrate the significantly modified AIM-120C missile's capabilities. A nine-shot (6 AF/3 Navy) OT&E will follow using the first Phase 3 production missiles. This test (FOT&E 4A) will be conducted by the Air Force's Air Combat Command and Navy's Air Test and Evaluation Squadron under AFOTEC and COMOPTEVFOR monitor, respectively.

TEST & EVALUATION ASSESSMENT

FOT&E(2) testing demonstrated fulfillment of the weapons effectiveness requirements in both countermeasure and non-countermeasure environments. Missile reliability, previously evaluated as unsatisfactory during IOT&E and FOT&E(1), was demonstrated to exceed user requirements by a wide margin during FOT&E(2). Rigorous FOT&E(2) testing of the "All Aspect Launch and Track" requirement called for 28 percent of the shots traversing the target's beam aspect. Another area of FOT&E(2) emphasis was missile effectiveness in the presence of targets employing self-screening chaff; 21 percent of launches were against such targets. Although significant improvements from IOT&E

performance were noted, concerns were not completely alleviated regarding missile capabilities in these two challenging environments.

FOT&E(3A) was conducted by the Air Force's 53d Wing and Navy's Air Test and Evaluation Squadron (AIRTEVRON) Nine (VX-9) at the Eglin Gulf Test Range, Eglin AFB, FL; White Sands Missile Range, NM; Utah Test and Training Range, UT; and NAWCWPNS Sea Range, Pt. Mugu, CA (NAWC-PM) from August 1996-August 1999 in operationally realistic scenarios. FOT&E(3A) was conducted to verify operational effectiveness and suitability of AIM-120B/C hardware and software updates (Lot 7/8/9/10 hardware, Tape 7 Revision 6, and Tape 7 Revision 7 for the AIM-120C and Tape 5 Revision 3 for the AIM-120B) verify correction of deficiencies and complete deferred or incomplete OT&E. Further details will be presented in the AMRAAM FOT&E(3A) Final Report. The anticipated publication date for this document is November 2000.

LFT&E results indicate that the P^3I warhead works as designed. The final AMRAAM LFT&E Tests and Analyses Plans and Products (TAPP) Report is in review. Results indicate that the P^3I warhead works as planned. Collection and evaluation of target damage data from the arena tests showed that the P^3I warhead produced multiple fragment perforations and some internal component damage in the test targets. LFT&E was conducted on the basis of the information contained in the AMRAAM P^3I TAPP version 4.1 and previously published data. DOT&E will publish its independent LFT&E report in early 2001.

AIR FORCE MISSION SUPPORT SYSTEM (AFMSS)

MPS III

PFPS

Air Force ACAT IAC Program

Total Number of Systems:	2,900
Total Program Cost (TY$):	$652M
Average Unit Cost (TY$):	N/A
Full-rate production	
Blocks C2.0, C2.1:	Incremental, Beginning FY97
Block C2.2:	Incremental, Beginning FY99
PFPS 3.01, 3.1:	Incremental, Beginning FY98

Prime Contractor

AFMSS/UNIX-based systems: Sanders, a Lockheed Martin Company

AFMSS/PFPS systems: Tybrin Corp.

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Air Force Mission Support System (AFMSS) program is developing a family of hardware and software products providing automated mission planning support for Air Force aircraft and precision-guided munitions. AFMSS contributes to all operational concepts of ***Joint Vision 2020***. AFMSS has become a significant command and control enhancement, providing ***information superiority*** to the ***dominant maneuver*** force.

The acquisition of AFMSS is evolutionary. Software for Mission Planning Systems (MPS) is UNIX-based, runs on UNIX workstations, and is being released in "Blocks." Portable Flight Planning Software (PFPS) versions are Microsoft Windows-based and run on IBM-compatible PCs. AFMSS uses several hardware configurations comprising Commercial Off-The-Shelf hardware to meet system requirements.

AFMSS software is loaded on a specific hardware configuration with Aircraft/Weapon/Electronics modules and other Installable Software Modules to provide a mission planning environment (MPE) for each aircraft type. Aircraft with electronic data transfer capability employ aircraft-unique hardware peripherals to prepare data transfer devices (DTDs) for uploading mission information into aircraft computers. The outputs of AFMSS-based MPEs are combat mission folders (consisting of maps, images, and flight information) and DTDs.

Eventually, all Air Force AFMSS users and Navy platforms using legacy mission planners will migrate to the Joint Mission Planning System (JMPS) architecture.

BACKGROUND INFORMATION

The AFMSS program began in 1990 with a UNIX-based automated mission planning system. Early versions had limited capabilities and did not fully meet user requirements. Development of **Block C2.0** software began in 1996 and was completed by 2QFY97. Block C2.0 MPEs for several aircraft types underwent operational test and evaluation during 1997 and 1998. Overall, the effectiveness of Block C2.0 was rated as marginally satisfactory for all users except the F-117A and the B-2. User requirements for the B-2 and F-117A MPEs were not met with Block C2.0 versions. Suitability for Block C2.0 was rated as unsatisfactory. Block C2.0 systems have now been upgraded or replaced by later AFMSS versions or by PFPS-based MPEs. **Block C2.1** software completed development in 1998, and development of **Block C2.2** software was completed in late CY98. The first Block C2.2 MPE, the B-2 v1.5, entered operational test and evaluation in December 1998. All MPS users are now employing Block C2.2 versions. **PFPS version 3.01** (for Windows-based PCs) provides basic flight planning capabilities for the following Air Force aircraft: A-10, B-1B, B-52H, C-141B, C-27A, E-3A, E-4B, EF-111, F-117A, F-15 (various), F-16 (various), C-130 (various), KC-10, C-135 (various), H-53, and T-38. Several Navy aircraft are also supported. The first MPE using PFPS 3.01 to enter operational test and evaluation was the F-16 Software Capabilities Upgrade (SCU) 3 Plus in May 1998. **PFPS 3.1** mission planning software recently completed development and has been certified for use for a few aircraft types. Enhancements in PFPS 3.1 include three new aircraft types (C-17A, C-5, and H-60), expanded weapon delivery functions, air refueling track editing, multiple routes, terrain masking, improved threat overlays, and other tools for airdrops and helicopter operations.

TEST & EVALUATION ACTIVITY

An operational test and evaluation, ranging in length from a few days to several months, is conducted for each aircraft's MPE. Qualified operations test personnel and experienced operational aircrews plan missions under operationally representative conditions and time constraints to determine if the MPEs are able to meet requirements to generate mission plans in a timely manner. For aircraft with data transfer devices, planners transfer missions to cartridges and the accuracy of data loaded into the aircraft is checked. Suitability data are also collected for some MPE types.

Table 1 shows aircraft MPE versions that have completed operational testing during FY00.

Table 1. Summary of FY00 AFMSS OT&E Activity

Operational Test Organization	AFMSS Block C2.2 Versions	PFPS 3.01 Versions	PFPS 3.1 Versions
AFOTEC Det 2, Eglin AFB, FL		C-17 sp3	
28th Test Squadron, Air Warfare Center (AWFC), Eglin AFB, FL	J-2 Ver 3.2 and Ver 4.0 -16 PO4B 50T5 Ver 4.32 and Ver 4.32 with WCMD Ver 4.01.1 B-1B Ver 1.2	A-10 F-16 50T5 CSS	Basic PFPS 3.1 ** PFPS for Windows NT F-16 SCU3PM
72nd Test and Evaluation Squadron of AWFC, Whiteman AFB, MO	B-2 Ver 2.0		
33rd Flight Test Squadron of Air Mobility Warfare Center (AMWC), Ft. Dix, NJ		KC-135E KC-135R C-141	
Det 1, 53rd Test and Evaluation Group, Holloman AFB, NM	F-117A Ver 3.1.2* and Ver 4.0.1*		

* Test reports on these systems have not yet been made available to DOT&E.
** This test also evaluated flight performance modules for C-130 and MH-53 aircraft types.

Block C2.2 MPEs: Five Block C2.2 MPEs have undergone operational test and evaluation in FY 2000: those for U-2, F-16 PO4B 50T5, B-1B, B-2, and the F-117A. All Block C2.2 systems were Y2K compliant and were replacements for earlier MPE versions. Operational test and evaluation of **U-2** MPE version 3.2 was completed in January 2000. The system was rated “satisfactory” for basic flight planning needs and was recommended for release. However, some important test issues were not resolved favorably, and 18 deficiencies remained open. The most significant deficiency was incorrect prioritization of Navigational Aids. The system still had many uncorrected deficiencies identified during earlier tests. An additional **U-2** MPE release 4.0 completed OT&E in July 2000. The system was rated overall satisfactory. Eighteen deficiencies were reported, the most significant ones being related to display and prioritization of navigation aids. Testing of software for the **F-16 PO4B 50T5** version 4.32 was completed in October 1999. However, the release of test results was placed on hold until June 2000 because of deficiencies in the aircraft’s Operational Flight Program (OFP). In the final test report, after OFP problems were corrected, the system was rated as satisfactory for basic flight planning needs. Forty-seven deficiencies were identified during the test. The 28th Test Squadron tested a version of the MPE for the F-16 PO4B 50T5 which included an A/W/E for the **Wind Corrected Munition Dispenser** (WCMD) in August 2000. The system was recommended for release, but with a marginal rating. There were several deficiencies with the WCMD planning tools, which taken together, reduced usability and caused extra work to develop mission plans. There were 21 deficiencies reported against the A/W/E, not counting those against the basic F-16 PO4B MPE. The most recent **B-1B** MPE, version 1.2, was tested in March and April 2000. Whereas the previous B-1B release (version 1.1) had not been recommended for operational use, version 1.2 was rated overall as “satisfactory.” Nevertheless, two test issues (meeting user needs and suitability) did not receive satisfactory ratings. There are still several significant usability issues that increase planning time and lead to risk of errors. Additionally, there is an open suitability concern because the hardware for preparing data transfer cartridges is a single point-of-failure item and units are not provided with spares. Failure of this item would prevent a deployed unit from fulfilling their wartime mission. Thirteen new deficiencies were identified during test of version 1.2. These are in addition to 32 uncorrected deficiencies from earlier releases. Version 2.0 of the **B-2** MPE was tested in early FY00 in conjunction with operational testing of a new release of aircraft software (version P1.1). This MPE also included version 3.2.1 of CLOAR. For the first time, the B-2 MPE was rated overall satisfactory. The current version 2.0 enables planners to achieve the required 8-hour planning timeline for a wartime mission and the latest CLOAR version 3.2.1 contains improvements that make it a usable tool for the first time. While CLOAR can provide acceptable routes, care must be taken to constrain potential route choices and to choose proper optimization settings. Improvements are still needed in a number of areas (e.g., printed products). Briefings and correspondence indicate that **F-117A** MPE version 3.1.2 was tested and released for operational use in April 2000. However, a test report on this system was never completed. The latest F-117A MPE, version 4.0.1, completed testing in August 2000 and was released for operational use. A test report on version 4.0.1 will be available in October 2000. Discussion with test team personnel indicates that both version 3.1.2 and version 4.0.1 were rated as marginally satisfactory for effectiveness because the planning times slightly exceeded requirements.

<u>FPS 3.01 MPEs</u>: The basic software for PFPS version 3.01 was tested during FY98. The software was recommended for release, with the exception of the threat depiction tool. The threat depiction tool was found to present incorrect information on terrain masking results. Although the PFPS software has embedded flight performance modules for many aircraft types, MPEs for each aircraft type are still individually tested and certified before operational use.

Fiscal Year 2000 PFPS 3.01 tests included OT&E of the PFPS-based Cartridge Support Software (CSS) for the **F-16 50T5**. The 28th Test Squadron completed this test in October 1999. Effectiveness and suitability were both resolved as satisfactory. Twelve deficiencies were identified during testing but none were high priority. The 33rd Flight Test Squadron tested a mission planning system for the **KC-135E** using PFPS 3.01 in December 1999. Because testing showed that a data transfer device could not be prepared using this system, the planning system was certified for basic flight planning only. A report for this testing has not been distributed. The 28th Test Squadron completed testing of the **A-10** mission planning capability in December 1999. All test issues were resolved as satisfactory, including the ability to upload data to the aircraft via a data transfer cartridge. Forty-one deficiencies identified during the test remain open. The 33rd Flight Test Squadron completed OT&E of the **C-141** mission planning system based on PFPS 3.01 in January 2000. All critical operational issues were rated as satisfactory. However, there were eight deficiencies. The most significant deficiency reports were on the inadequacy of training for the system. The 33rd Flight Test Squadron tested a **KC-135R** planning system, version 1.9.2, in January and February 2000. The system was found satisfactory overall, but several test measures were rated as unsatisfactory or inadequate. Problems were encountered loading data for transfer to the aircraft. Loss of power was experienced when shutting down the system on battery power. Training was also rated as inadequate. Twelve deficiencies were reported against the system. Detachment 2 of AFOTEC conducted OT&E of the planning system for the **C-17A**, Spiral 3 in May and June 2000. The system was rated overall as effective and suitable, with 12 minor deficiencies. Technical orders were rated as unacceptable, and some problems were encountered loading software and data into the laptop computer.

<u>PFPS 3.1 MPEs:</u> The basic PFPS 3.1 software underwent OT&E from December 1999-March 2000. The system was rated as effective and suitable, but 74 deficiencies that did not significantly interfere with effective mission planning remained open at the conclusion of the test. Among the principal shortcomings discovered during testing were lack of capability to import threat data bases and lack of training. A version of PFPS 3.1 for Windows NT was tested in April 2000. No significant problems (beyond those in Basic PFPS 3.1) were noted. A Mission Planning Environment for the **F-16 SCU 3PM** based on PFPS 3.1 underwent OT&E in March and April 2000. The system was found satisfactory in effectiveness and suitability. Sixteen new deficiencies were reported.

TEST & EVALUATION ASSESSMENT

OT&E tests performed on AFMSS mission planning environments during FY00 indicate that there have been improvements in effectiveness and suitability of more recent releases and versions.

Available test reports for UNIX-based systems with Block C2.2 core all reported overall satisfactory except for the B-1B, the WCMD A/W/E used on the F-16 PO4B 50T5, and the F-117A. While there were factors preventing a fully satisfactory rating of the B-1B planning system, it was a major improvement over the previous version, particularly for functions related to Joint Direct Attack Munition planning. The WCMD A/W/E used on the F-16 PO4B 50T5 had a number of shortcomings but was recommended for release provided users were informed of workarounds. The F-117A MPE is still exceeding the 8-hour planning time requirement by 1-2 hours. UNIX-based AFMSS users still record significant usability complaints. Nevertheless, user dissatisfaction is decreasing and mission planning times are improving as the system matures and earlier deficiencies are corrected in new releases. Faster hardware is also leading to planning time reductions. AFMSS users with complex missions (e.g., B-1B, B-2, and F-117A) are likely to continue experiencing a significant number of usability problems.

All PFPS 3.01 and 3.1 systems tested in FY00, and for which test reports are available, received ratings of satisfactory for effectiveness and suitability. These users have fewer major usability complaints, and the newer 3.1 version has a number of enhancements over earlier configurations. Although there remain a significant number of open deficiencies for PFPS systems, user feedback on version 3.1 has been mostly favorable.

DOT&E recommends that the Air Force continue to focus attention and funding on fixing deficiencies and improving AFMSS products. It is certain that these systems will be in service for several more years before capabilities can be migrated to systems based on JMPS.

AIRBORNE LASER (ABL)

Air Force ACAT ID Program		**Prime Contractor**
Total Number of Aircraft:	7	Boeing
Total Program Cost (TY$):	$6,335M	
Average Unit Cost (TY$):	$528M	
Full-rate production:	FY08	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Airborne Laser (ABL) is intended to shoot down enemy Theater Ballistic Missiles (TBMs) during their powered boost phase of flight. The ABL engagement concept calls for the laser to focus on a distant missile's booster skin, rupturing it or damaging it sufficiently to cause the missile to lose thrust or cause a loss of flight control and fall short of its intended target. The ABL engagement of TBMs in the boost phase is intended to result in the negation of the missile before decoys, warheads, or submunitions are deployed.

The aircraft will be a modified Boeing 747-400F (freighter), carrying a megawatt-class Chemical Oxygen Iodine Laser operating in the near infrared (1.315 microns). In addition to the laser, the ABL system will also have a Beam-Control/Fire-Control (BC/FC) system and a Battle Management, Command, Control, Communications, Computers, and Intelligence (BM/C^4I) system. The BM/C^4I system will autonomously acquire the target and manage much of the engagement. After a target has been acquired, the BC/FC system will actively track the missile and use adaptive optics to compensate for the degrading effects of atmospheric turbulence on the laser beam's path. Once the BC/FC system has established a track, the high-energy laser will irradiate the missile until it has been negated.

ABL will be rapidly deployable and add a boost-phase layer to the Theater Missile Defense's (TMD) Family of Systems. It will be positioned behind the forward line of friendly troops and moved closer toward enemy airspace as local air superiority is attained. The Air Force is proposing a seven aircraft fleet, and envisions that five aircraft would deploy to support two 24-hour combat air patrols in a theater.

Theater missile defense is a central aspect of ***Joint Vision 2020***. ABL will utilize technological innovation to achieve ***precision engagement***. Operationally, it will provide ***full-dimensional protection*** of U.S. and friendly forces, cities, ports, airfields, and other infrastructure in the theater.

BACKGROUND INFORMATION

The technologies supporting ABL have evolved from more than 25 years of DoD and Air Force Research Laboratory (at Kirtland AFB, NM) work in the areas of laser power generation, pointing and tracking, and adaptive optics. In the early 1980s, the laboratory operated the Airborne Laser Laboratory, which successfully shot down five AIM-9 air-to-air missiles and a BQM-34 simulated cruise missile at White Sands Missile Range, NM. In addition, the Strategic Defense Initiative Organization (now the Ballistic Missile Defense Organization) funded a number of efforts relating to adaptive optics and beam control. These technology investments established the technical feasibility of the airborne laser concept.

In FY94, the Air Force launched a formal Airborne Laser program that awarded two separate concept design contracts to competing teams. The program passed Milestone I and entered the Program Definition and Risk Reduction (PDRR) phase in November 1996. The Air Force selected a single team from the two competing concept teams by awarding the contract to the team of Boeing (prime), TRW (laser), and Lockheed Martin (beam control).

During the PDRR phase, one ABL system will be built to demonstrate the feasibility of the system. The high-energy laser on the PDRR system will have about half the energy of the full production-representative system, and a number of the other subsystems will also not be production-representative. However, the PDRR phase—which will culminate with full-up flight tests against representative TBMs in FY03-04—will be an important step in validating the ABL concept and retiring critical areas of risk.

As the PDRR system is integrated, a series of ground and flight tests will be conducted that incrementally demonstrate capability. The PDRR test program is closely tied to the integration schedule of the PDRR system, with ground and flight test activities scheduled after each stage of segment integration. The segments of the PDRR system will be integrated in three major steps:

- Integration of the BM/C^4I on the aircraft.
- Integration of the Beam-Control and Fire-Control segment with the BM/C^4I and aircraft segments.

- Integration of the high-energy Chemical Oxygen Iodine Laser with other segments on the aircraft.

There are several interim milestones during PDRR. The program successfully passed the first Authority to Proceed (ATP-1) decision in summer 1998. This decision allowed the Air Force to commit to the purchase of the commercial 747-400F, which will be used for the PDRR system. The ATP-1 decision was based on: (1) demonstration of a lightweight laser module; (2) demonstration of active tracking; (3) characterization of atmospheric turbulence; and (4) demonstration of compensation and fine tracking.

As currently planned, an ATP-2 review is scheduled for late FY02. Current ATP-2 criteria are: (1) demonstrating performance of the integrated PDRR beam control system at low power; (2) laser scaling and multi-module operation of the PDRR laser modules; and (3) an integrated surveillance system performance. This review will authorize the long-lead purchase of the EMD aircraft.

The EMD phase is scheduled to begin in March 2004 and end two years later. During EMD, a full-power production-representative ABL system will be built and tested. Details of this phase are still being developed, but (as discussed in the Assessment section) this appears to be an inadequate amount of time planned for this phase of the program.

The ABL has experienced several budget cuts in recent years. A $25 million funding cut in FY99 caused a program restructure, resulting in the PDRR phase being lengthened by one year. Most other program dates (ATP-2, MSII, and MS III) were correspondingly delayed by a year. Early in FY00, a series of budget cuts totaling over $900 million between FY01-05 were proposed in the President's budget. Congress has restored most of FY01 funding, and the Air Force has committed to restore funds in FY02-03. Although this results in full funding for PDRR, a shortfall remains for the EMD phase slated to begin in FY04.

During FY00, the engineering and design of the ABL system progressed according to schedule. The program took delivery of the PDRR aircraft from Boeing's commercial assembly line in January, and modifications began that same month at Boeing's Wichita plant. A system-level critical design review was held in April 2000.

TEST & EVALUATION ACTIVITY

Revision of the TEMP continued during this period, documenting changes made to the program as a result of budget cuts and program restructure. The System Program Office has committed to finish this update and submit it to OSD in early FY01.

The program has been actively collecting data to address one of the most challenging issues facing the ABL—atmospheric turbulence. Atmospheric data have been collected in Korea and Southwest Asia over four seasons for several years using several different techniques; e.g., balloons and aerothermal probes. One issue has been correlating the data made with these different techniques, and converting these measurements to path-integrated values of turbulence relevant to ABL engagements. In FY00, a stellar scintillometer was used to measure turbulence in these theaters, with the intent to provide a more direct measure of path-integrated turbulence and correlate the measurements taken with other techniques.

Early in PDRR, tracking and compensation demonstrations in support of ATP-1 were conducted at White Sands Missile Range and at MIT Lincoln Laboratory's Firepond facility. More recently, additional tracking and compensation tests were conducted at White Sands' North Oscura Peak. The ranges at North Oscura Peak are longer (~50 km) than in the previous tests (~5 km), and the path-integrated turbulence levels should be more representative of ABL engagements. Dynamic cooperative tests were completed in 3QFY99, and dynamic, non-cooperative tests were done in 2QFY00.

Laser development and testing has continued, and contributed to the final laser-module design available for testing in 3QFY01. Several other development and test phases are planned during PDRR, leading up to the mature PDRR and EMD laser designs.

Another area of ongoing test activity involves lethality mechanisms. Several experiments have been conducted by the Air Force Research Laboratory to measure fundamental thermodynamic and optical properties of relevant materials, including some countermeasure candidates. These measurements include high temperature properties and the response of materials to laser radiation. To gain a better understanding of the internal operating condition of an in-flight missile, critical components and sub-systems have been investigated under simulated flight and propulsive conditions.

TEST & EVALUATION ASSESSMENT

The ABL is a completely new type of weapon system. Besides presenting a challenging set of engineering issues to the contractors, the ABL also presents a new set of challenges in conducting adequate operational test and evaluation. The ABL will be a very complex system, and will have many state-of-the-art systems; e.g., gas lasers and optics that normally exist in laboratory environments rather than in operational, flying military systems. Thus, a very thorough evaluation of operational effectiveness and suitability must be conducted to ensure that the ABL can perform its mission and be safely maintained in the operational environment with acceptable levels of readiness.

The test activities planned for PDRR should address the fundamental ABL issues of atmospheric turbulence and compensation, lethality, laser development, and integrated system performance. Testing should adequately demonstrate, in a logical progression, individual segment performance as well as increased capability and the ability of the segments to operate together as an integrated system. Overall, the PDRR program contains reasonable amounts and types of tests, but the schedule is ambitious and clearly success-oriented.

An even more ambitious schedule is envisioned for the EMD phase: 24 months to fully integrate and operationally test a production-representative ABL. The abbreviated EMD phase was originally justified by assuming that the PDRR and EMD systems would be identical, except for the number of laser modules. However, the PDRR and EMD designs are beginning to differ more significantly, and this is no longer a valid approach. The current EMD plan also results in a high degree of concurrency between the PDRR and EMD phases, which increases risk and may not provide adequate time to transfer lessons learned during PDRR testing into the EMD design. Furthermore, when compared to other major acquisition programs that are less complex, the 24-month EMD program is alarmingly short. We believe that the proposed EMD schedule for ABL, a high-technical risk program, allows for no technical problems or test failures, and the many integration and test activities cannot all physically be accomplished in the time allotted for EMD.

There will be significant challenges involved in adequately testing and evaluating ABL against an appropriate cross-section of its intended targets. Specific concerns include the following:

- The ABL STAR lists approximately 30 threats that the ABL is required to negate. These missiles include a diverse range of operating characteristics, including liquid and solid-fueled, single and multi-stage, and metal and composite body missiles. There may be other important lethality considerations among these missiles, and the missiles may also have different range and dynamic characteristics. However, it is unlikely that more than one or two of these missiles will be available for actual ABL testing, and it is unclear how the program intends to demonstrate effectiveness against the array of different missile types.

- The ABL ORD specifies minimum and maximum values of range, azimuth angle, and elevation angles for ABL engagements. Besides these parameters, the level of atmospheric turbulence will have an important effect on ABL's effectiveness. Other variables that may be important include whether the engagement is conducted during the day or at night, and the presence of clouds. However, it may be difficult to perform end-to-end operational tests that cover all of the important areas of this parameter space. Although the ABL's operational requirements are based on a turbulence level of "one times clear 1 night" (a measure of turbulence strength), the results of the atmospheric data collected to date indicate that this turbulence level will occur only 50 percent of the time. In contrast, 80 percent of the expected conditions fall within the turbulence level "two times clear 1 night." These results will be used to shape ABL's OT&E program.

- Based on the threats, range, and geometry, there will also be a set of dynamic conditions that the ABL encounters during an engagement. This parameter space may also have important effects on ABL performance, but at a more fundamental level. For example, the exact location of where the high-energy laser is aimed may have an important effect on lethality. The ability of the ABL to correctly identify the type of TBM and determine the optimal location to place this beam may depend on the dynamics and geometry of the engagement, and should thus be evaluated across the breadth of threat missiles and engagement conditions. An additional challenge will be the evaluation of ABL's effectiveness against salvos, or multiple, near simultaneous launches.

Other key test issues include:

- Countermeasures may be employed to reduce ABL's effectiveness. Likely candidates need to be identified and included in ABL's test program.

- As mentioned above, producing a system that is operationally suitable will be a challenge. The ABL system may have new and unique maintenance requirements compared to other airborne military systems. Thus, adequately assessing the reliability, maintainability, availability, safety, and the required logistics support of the ABL in operationally realistic conditions should be an important part of OT&E.

- In the ABL ORD, a successful negation occurs if the thrust of the missile is terminated by the ABL at a specified time before it would have normally terminated. This will cause the missile to fall short of its intended target. However, since the ABL may not catastrophically destroy the missile, there is a chance that the warhead(s) could still cause damage. Also, when the thrust termination requirement was developed, some assumptions were made regarding the remainder of the missile's flight path. These assumptions should be verified during the test program, as well as assessing the warhead behavior after an ABL engagement. Again, these evaluations should be performed across the breadth of targets documented in the STAR.

- The exit criteria for Milestone II need to be resolved soon to allow advance planning. One of the most important of these criteria concerns the number of threat representative end-to-end missile negations required before Milestone II. This criterion was modified early in FY00 at the Integrating IPT level from one to three missile negations. However, more detailed planning of the test scenarios and conditions have stalled awaiting convening of an OIPT to ratify this change. Because of the importance and visibility of these demonstrations, we encourage the planning of these tests to begin as soon as possible.

B-1B CONVENTIONAL MISSION UPGRADE PROGRAM (CMUP)

Air Force ACAT IC Program		**Prime Contractor**
Total Number of Systems:	93	Boeing North American Aviation
Total Program Cost (TY$):	$3,049M	
Average Unit Cost (TY$):	$32.8M	
Full-rate production:	2QFY03	
SEP Production	3QFY03	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The B-1B *Lancer* is a long-range, supersonic bomber, capable of flying intercontinental missions. With air refueling, it can attack targets anywhere in the world and return to bases in the U.S. The B-1B's design features a swing-wing, four F-101-GE-102 afterburning turbofan engines, and a defensive avionics system comprising primarily the AN/ALQ-161A radio frequency surveillance and ECM system (i.e., a self-protection jammer), and a tail warning system coupled to a flare/chaff dispenser. The offensive avionics system provides precise navigation and supports delivery of weapons. B-1Bs are based at Dyess AFB, TX; Ellsworth AFB, SD; McConnell AFB, KS; Robins AFB, GA; and Mountain Home AFB, ID. Initial operational capability was achieved in September 1986, with the last aircraft delivered in April 1988.

The B-1B Conventional Mission Upgrade Program (CMUP) began in 1993. Changes being carried out in the CMUP are intended to enhance conventional weapons delivery capabilities, provide increased situational awareness, increase survivability, and improve supportability. These improvementswill equip the B-1B to provide ***precision engagement*** by attacking strategic and tactical targets at all stages of conflict. CMUP will also improve the B-1B's ***full-dimensional protection*** capabilities.

CMUP Block C modifications in 1996 made the B-1B capable of delivering Cluster Bomb Units (CBUs) in addition to the Mk-82 500-pound bombs that the bomber could already deliver. The Block D upgrade adds capabilities for employment of near-precision Joint Direct Attack Munitions (JDAM), Global Positioning System (GPS) and new radios needed for conventional warfare, and provisions for the ALE-50 Towed Decoy System (TDS). Upon incorporation of Block D changes, the B-1B would require re-configuration to be capable of delivering nuclear weapons.

Remaining phases of CMUP consist of two principal "blocks:":

- Block E: Upgrades computers for increased weapon flexibility to be able to employ a different weapon type in each of the three weapon bays and for better supportability. Integrates Wind Corrected Munition Dispenser (WCMD) weapons for more accurate delivery of cluster bomb munitions. Enables integration of the Joint Stand Off Weapon (JSOW) and the Joint Air-to-Surface Standoff Missile (JASSM).
- Block F, Defensive System Upgrade Program (DSUP): Upgrades the defensive avionics suite by integrating a radar warning receiver, a radio frequency countermeasures system, and a fiber-optic towed decoy.

BACKGROUND INFORMATION:

OT&E of the B-1B began in July 1984 with the delivery of the first production aircraft. FOT&E on the Block B software upgrade was completed in February 1995, and FOT&E of Block C (CBU Upgrade) was completed in April 1996. Block D IOT&E was completed in September 1998 and production began in January 1999 (Milestone III). Block D upgrades are still in production, with approximately two-thirds of the aircraft fleet modified. Block D production will be completed in March 2002. The ALE-50 Towed Decoy System completed IOT&E in October 1997, followed by a Milestone III decision in January 1998. Approximately one-fourth of the fleet has been modified, with production planned to end in FY04.

Test planning for the B-1B CMUP is covered by a Capstone TEMP and annexes for each major upgrade. DOT&E initially approved the CMUP Capstone TEMP and the Block D annex on January 6, 1995. Subsequently, the following TEMP documents have been approved by DOT&E on the dates shown:

- Block F (DSUP) TEMP annex — March 20, 1997
- Revised B-1B CMUP Capstone TEMP — September 11, 1997
- Block E (Computers and WCMD) TEMP annex — September 11, 1997

During late FY99, Blocks E and F were restructured by the Air Force because of schedule changes and cost growth in both programs. Both Blocks E and F have undergone further slips because of problems in developing Avionics Flight Software (AFS) and in part due to a Boeing engineer's strike. As a result, a Block E Acquisition Program Baseline change request was submitted and approved August 10, 2000, with the proposed Block E Milestone III date slipped to January 2003, and the Block F

Milestone III date has slipped 18 months. The future of the Block F DSUP is uncertain as a result of the Air Force's decision not to fund production of DSUP in the FY02 Budget Estimate Submission. Restoration of production funding will be reconsidered in the planning for the FY04 budget. As a result, TEMP revisions for both Block E and F have been initiated.

The B-1B CMUP was placed on the Annual T&E Oversight List for LFT&E in December 1993. A waiver from full-up, system-level Live Fire Testing was approved in January 1995, together with an Alternative Plan for meeting the LFT&E objectives. All testing has been completed. A DOT&E independent evaluation for Block D was completed, and a classified report was sent to Congress in January 1999. The Live Fire evaluation will be updated to reflect the changes implemented in Block E and Block F, and an updated report will be submitted prior to Milestone III for each Block. The update reports will account for effects of the Block upgrades (if any) on LFT&E findings.

TEST & EVALUATION ACTIVITY

OT&E activity during FY00 was limited to Force Development Evaluation (FDE) of the aircraft, FDE of Mission Planning Equipment, and Operational Assessments (OAs) of Blocks E and F.

Fiscal Year 2000 FDE was conducted on Block D aircraft to identify remaining deficiencies, evaluate the operational impact of changes, assist in developing tactics, and re-evaluate the B-1B against changing operational needs. FDE is conducted continuously but is funded and tasked in fiscal-year increments. FDE activities included operational testing of fixes to the B-1B Block D's radios. Upon integration of the ARC-210 radio during Block D modifications, UHF reception and transmission became weak, scratchy and unreliable. The causes of these problems were identified, engineering changes and fixes were determined, and installations are underway or planned. Mission planning FDE was also conducted in March and April 2000 to assess the most recent upgrades.

Block E is currently in EMD, with DT&E flight testing scheduled to begin in early FY01. Block F is also currently in EMD, with DT&E flight testing scheduled to begin in late FY01. Ongoing OAs for Blocks E and F intend to identify and assess major impacts affecting the potential effectiveness and suitability of the Block upgrades. The Block E and F OAs began in FY98, and will continue through approximately mid-FY02.

TEST & EVALUATION ASSESSMENT

Force Development Evaluation

Final design modifications to correct Block D radio problems were completed in June 2000 and began FDE testing in September 2000. Upon completion of testing, depot-level installations of engineering changes will begin and plan to be completed by March 2002.

FDE of Mission Planning Equipment version 1.2 resulted in an overall "satisfactory" rating, although several significant usability issues remain that increase planning time and lead to risk of errors. There is also an open suitability concern because the hardware for preparing data transfer cartridges is a single-point-of-failure item and units are not provided with spares. Failure of this item would prevent a deployed unit from fulfilling their wartime mission. Thirteen new deficiencies were identified during test of Version 1.2 (none of these were high priority), in addition to 32 uncorrected deficiencies from earlier releases. Version 1.2 was a significant improvement over the earlier version in route planning and functions related to JDAM planning. The previous B-1B release (version 1.1) had not been recommended for operational use by the OT&E test team; however, Air Combat Command certified it for operational use during Operation Allied Force.

Block E

Block E weapon system upgrades are progressing with moderate to high risk that requirements may not be met upon completion of IOT&E, even in light of re-baselining of the program. Operational Assessment of the Block E program identified several areas of risk that may impact the effectiveness of the upgrades and/or the adequacy of the OT&E test program.

The highest risk associated with Block E is whether the design of cockpit controls and displays will be adequate to support weapon delivery from the aircraft. In order for guided weapons to reach their targets, the B-1B must release them within a Launch Acceptability Region (LAR). The current design provides a simple display to assist the Weapon Systems Officer but no display for the pilot. The display does not provide adequate dynamic steering and timing cues to help the crew arrive in the LAR for weapon release, especially in cases where the aircraft has had to maneuver off its planned flight path. Assessments by operational testers and studies by the contractor indicate that unless displays are improved, as many as 25 percent of smart weapons may not be employed. Alternate designs have been identified, but no direction or funding to implement a change has been provided.

A moderate risk is associated with test aircraft adequacy. At the current time, the Air Force plans to conduct Block E IOT&E with a single test aircraft. The test aircraft does not have the ALE-50 TDS installed. Configuration differences between the test aircraft and a fleet-representative aircraft could provide misleading test results. The single test aircraft may not be fully production-representative and an additional first production aircraft should be provided. This would increase the fidelity of flight tests and help reduce schedule risk. Plans are being revised to provide a production representative aircraft for IOT&E.

A second moderate risk concern is that the production configuration aircraft computer will not be available for IOT&E. Because of diminishing manufacturing sources, the version of computer hardware in the test aircraft (SP-103 Enhanced) cannot be produced in quantity. A later version (SP-103A) that will be produced does not become available until after testing. Risk will be mitigated by regression testing of the SP-103A after IOT&E but before all computers are produced. However, the planned approach will require retrofit of the SP-103A computer to early production aircraft via a Time Compliance Technical Order change.

DOT&E concurs with AFOTEC's current assessment that Block E development is progressing under the burden of an unexpectedly large number of software development problems. Additional potential problems were identified in the OA, and there remains a potential for unexpected IOT&E flight test problems due to the immaturity of Block E software and hardware. There is moderate to high risk that Block E may not fully meet operational effectiveness and suitability requirements.

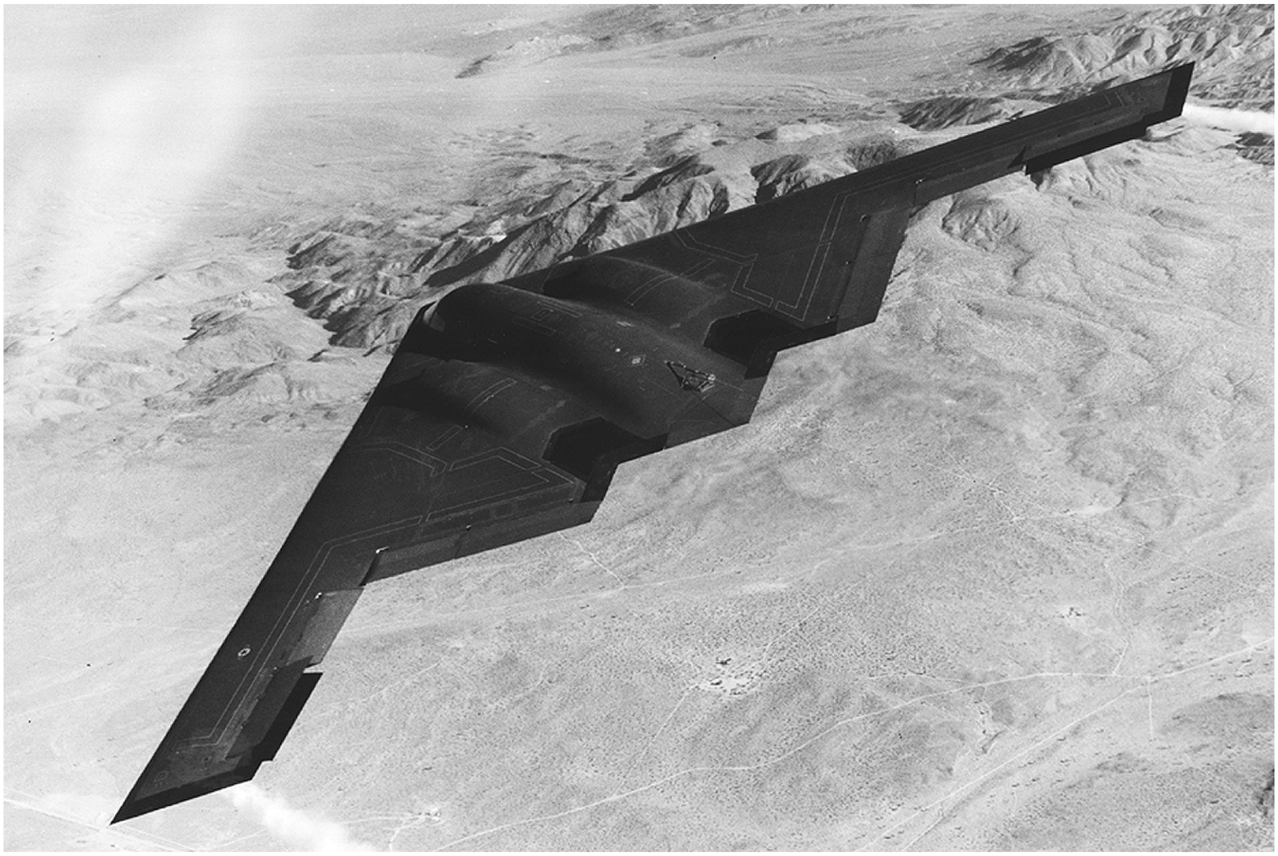
Block F

A major contributor to schedule slippages and cost growth in Block F has been delays in the Navy's Integrated Defensive Electromagnetic Countermeasures (IDECM) program. From the B-1B perspective, IDECM components are provided as Government Furnished Equipment to the B-1B. The T&E assessments for IDECM Blocks II and III relate to B-1B DSUP.

Since the re-baselining of DSUP in July 1999, the program had been "on track" to meet planned performance goals, however, the ongoing OA on Block F by AFOTEC identified several risk areas. These are moderate risk areas and include concern whether operationally representative threat data files will be available for IOT&E.

Previous OT&E of the current ALQ-161A system and the ALE-50 TDS showed that these systems are not effective against all the threshold threats identified in the current Operational Requirements Document. While the systems have some effectiveness against specific threats, the current systems cannot meet Reduction in Lethality requirements for all. Therefore, if a decision is made not to complete development and production of Block F defensive system upgrades, it would leave the B-1B unable to meet survivability requirements. This could seriously diminish the contribution of the B-1B in future conflicts. The B-1B may be limited to a stand-off role or use only after the air defense threat is suppressed.

B-2 *SPIRIT* ADVANCED TECHNOLOGY BOMBER



Air Force ACAT IC Program		**Prime Contractor**
Total Number of Systems:	21	Northrop Grumman Corporation
Total Program Cost (TY$):	$44,700M	
Average Unit Cost (TY$):	$1,175M	
Full-rate production:	N/A	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The B-2 builds on ***technical innovation*** and advancements in weapon delivery accuracy and low observable technologies to enhance the ***Joint Vision 2020*** operational concept of ***precision engagement.*** The aircraft also supports the concept of ***dominant maneuver*** through its ability to reach targets worldwide and to penetrate air defenses with minimal supporting forces.

The B-2 *Spirit* bomber is an all-wing, two-crew aircraft designed for worldwide conventional and nuclear weapon delivery missions. Propelled by four F-118 GE-100 turbofan engines, the bomber has twin side-by-side weapon bays, capable of carrying a total of approximately 44,000 pounds of weapons. The B-2 incorporates technologies that provide low observable (LO) characteristics; i.e., low radar cross-section as well as low infrared, visual, and acoustic signatures. Avionics include a multi-mode radar, Global Positioning System (GPS), a Defensive Management System (DMS) for radar warning functions, and a Terrain Following/Terrain Avoidance (TF/TA) system.

Operational aircraft deliveries to the Main Operating Base at Whiteman AFB, MO began in 1993, and Initial Operational Capability was reached in April 1997. Block 30 final version aircraft deliveries have now all been completed, and the 509th Bomb Wing now operates two squadrons of eight aircraft each. The remaining five aircraft are assigned either for test purposes or as "pipeline" aircraft undergoing depot level maintenance. For nuclear missions, the B-2 can carry and deliver the B-61 and B-83 type gravity nuclear weapons. Table 1 lists the conventional weapons that can be carried by the B-2.

Table 1. Conventional Weapons Carried by the B-2

Weapon	Type	Quantity Carried
GBU-31 (principal weapon)	GPS-guided Joint Direct Attack Munition (JDAM) with 2,000-pound Mk-84 warhead or BLU-109 penetrator warhead	16
GBU-37	GPS-guided 4,700-pound penetration weapon	8
Mk-82	500-pound general purpose bomb	80
Mk-84	2,000-pound general purpose bomb	16
CBU-87/89/97	Cluster bombs	34
M-117	750-pound general purpose bomb	34
Mk-62	500-pound sea mine	80
AGM-154	Joint Standoff Weapon (JSOW) (currently being integrated and tested)	16

BACKGROUND INFORMATION

A combined DT&E/IOT&E program for the B-2 began at Edwards AFB, CA in 1989. Dedicated AFOTEC IOT&E test team pilots conducted system assessments during operationally realistic DT&E flights. In addition, a series of test flights was conducted against individual threat systems and an integrated air defense system to evaluate survivability. IOT&E ended in July 1997.

The B-2 only partially met operational requirements at the conclusion of IOT&E. The aircraft had significant operational utility for selected missions although several sub-systems failed to meet expected performance levels or their development had not been completed at that time. Table 2 summarizes IOT&E results.

Table 2. B-2 IOT&E Findings

Critical Operational Issue (COI)	IOT&E Finding
Rapid Strike	Met requirements only for pre-planned missions (because of Mission Planning System (MPS) deficiencies). Generation and launch times not met.
Sustained Operations	Did not meet requirements for Mission Capable Rate (MCR) or Sortie Generation Rate (SGR).
Mission Survivability	Met requirements with adequate mission planning, tactics, and support package. Defensive Management System (DMS) unsatisfactory.
Weapons Effectiveness	Met requirements.
Reliability, Maintainability, and Deployability	Did not meet requirements because of poor LO reliability/maintainability and need for environmental shelters at deployed locations.

IOT&E was followed by FOT&E (Phase I) conducted by AFOTEC at Whiteman AFB through December 1998. This was followed in turn by an ongoing Force Development Evaluation (FDE). FDE identifies deficiencies, assesses operational effectiveness and suitability, assists in the development of tactics, and re-evaluates the B-2 against changing operational needs. The 72nd Test and Evaluation Squadron, Air Combat Command conducts FDE in fiscal year increments. FDE began in January 1999 and will continue for the foreseeable future. The first FDE period (January-December 1999) contained the Operation Allied Force (OAF) period. FOT&E and FDE activities leveraged normal training operations as additional data gathering opportunities.

Since the end of IOT&E, the B-2 development program has focused on upgrades aimed at correcting deficiencies found in testing, as well as enhancements to the aircraft's original capabilities. Post-baseline upgrades initiated to date address the following:

Deficiencies:

- Mission Planning System (MPS) – Faster computers and software upgrades to improve usability and reduce planning time.
- Defensive Management System (DMS) – Improvements in recent P1.1 aircraft software and Mission Data File (MDF).
- Low Observable (LO) reliability and maintainability – Improved materials, faster cure times, improved application techniques, and better management of maintenance actions. Began programs for Alternate High Frequency Materials (AHFM), Advanced Top Coat system, and improved durability tiles. Tailpipe repair efforts continue as well as efforts to extend material life of outer mold line. LO verification tools and technical data improvements are being pursued.
- Terrain Following/Terrain Avoidance (TF/TA) system – Improvements in recent P1.1 aircraft software.
- Auxiliary Power Unit (APU) and Environmental Control System (ECS) – Block 30 modification to allow APU to drive ECS while using external electrical power.

- Deployability – Initiated acquisition program to obtain deployable shelters for LO maintenance and environmental protection.

Capability Upgrades:

- Integrate Joint Standoff Weapon (JSOW) and incorporate Generic Weapon Interface System (GWIS).
- Integrate Enhanced GBU-28 weapon delivery capability.
- Integrate 500-pound JDAM (Mk-82) and develop Smart Bomb Rack Assembly (SBRA).
- Integrate SATCOM secure voice, Have Quick II, and data communications capabilities.
- Add Link 16, Center Instrument Display, and In-flight Re-planner.
- Integrate Joint Air-to-Surface Standoff Missile (JASSM).

The above initiatives are in various stages of completion and some are suffering from near-term funding shortfalls. Additional enhancements planned within the Five Year Defense Plan include:

Future Upgrades:

- Add MILSTAR EHF/SHF survivable SATCOM capability.
- Enhanced Digital Engine Controller (EDEC).
- Add Demand Assigned Multiple Access capability to SATCOM Radio.

The B-2 was added to the Annual T&E Oversight List for Live Fire Test and Evaluation in May 1995. DOT&E decided the requirements of Section 2366, Title 10, United States Code did not apply because the program was not expected to proceed beyond low-rate production. The Air Force initiated an LFT&E program that relied on modeling and simulation. However, the modeling and simulation was not completed and an Air Force assessment of B-2 vulnerability to live fire has yet to be accomplished.

TEST & EVALUATION ACTIVITY

Force Development Evaluation activity in FY00 concentrated on evaluating a new aircraft software release (Version P1.1) and an associated mission planning system software upgrade (Version 2.0). The FDE effort is focused on evaluation of corrections to areas that were found to be deficient at the conclusion of IOT&E and FOT&E (Phase I). Additionally, flight tests to evaluate Joint Standoff Weapon delivery capabilities and the new Generic Weapon Interface System were conducted.

Planning continued for the first deployable shelter evaluation, now scheduled for November 2000.

TEST & EVALUATION ASSESSMENT

B-2 OT&E progress is based on a review of FDE reports and discussions with test force personnel. An assessment is provided for each of the five Critical Operational Issues: Rapid Strike;

Sustained Operations; Mission Survivability; Weapons Effectiveness; and Reliability, Maintainability and Deployability.

Rapid Strike: This area is now satisfactory except for time to generate and launch, still being impacted by LO maintenance time. In IOT&E, AFOTEC assessed this area as meeting user requirements but for pre-planned missions only. Limitations of rapid strike capability resulted from immaturity of the Mission Planning System consisting of the Air Force Mission Support System (AFMSS) combined with a Common Low Observable Autorouter (CLOAR) and B-2 unique software. Rapid strike capabilities were also affected by the time to generate and launch the B-2. These times did not meet requirements due to the LO repair time (discussed below).

As a result of cumulative improvements, mission planning performance has improved so that planning time is no longer a bottleneck. AFMSS B-2 version 2.0 enables planners to achieve the required 8-hour planning timeline for a wartime mission. The latest CLOAR Version 3.2.1 contains improvements that make it a usable tool for the first time, provided care is taken to constrain potential route choices and to choose proper optimization settings. Improvements are still needed in a number of areas (e.g., printed products). However, overall MPS performance is now satisfactory.

A total of 29 FOT&E and FDE generation exercises have been conducted to date. Only 6 of the 29 exercises generated the required number of aircraft in the allotted time. The latest exercises, conducted in FY00, did meet requirements and represent improvements over the times predicted during IOT&E. However, LO maintenance timelines must be further improved to comply with the Operational ORD. The Passive Thermal Protection System (PTPS) panels are a constraint for nuclear mission generation due to the time required to install the PTPS frames into each aircraft.

TF/TA system improvements are incorporated in P1.1 aircraft software introduced in early 2000. Following IOT&E, operation was cleared down to 600-foot Set Clearance Plane (SCP). Low-level flight has now been demonstrated in development testing down to the ORD level of 200 feet SCP in clear weather and 400 feet SCP in light rain. Improvements resulted from changes to software that controlled radar illumination of the terrain and eliminated potential radar blind spots in turns. Operational testing of TF/TA improvements has not yet been performed.

Weapon System Reliability (WSR), which measures the probability that an aircraft will function correctly to reach the target and release weapons, is satisfactory. Based on current failure rates, WSR for the nuclear mission is estimated as between 96 and 99 percent, compared to a requirement of 88 percent. For a conventional mission, WSR is estimated to be between 82 and 90 percent for a 30-hour mission. In Operation Allied Force, B-2's demonstrated a WSR of 98 percent for 30-hour conventional missions.

Sustained Operations: This area did not meet user requirements in IOT&E. LO materials on the B-2 required high amounts of maintenance and had a time-consuming repair process with long cure times. This reduced the time aircraft were available for operational use, which kept Mission Capable Rates (MCRs) below the requirement. These problems increased the amount of time it took to prepare the B-2 for its next combat flight, reducing the number of sorties that could be flown in a given period. During IOT&E, the B-2 was rated incapable of achieving the required Sortie Generation Rate (SGR) due to unreliability and difficulty in maintaining the aircraft's LO system. The ability to sustain combat operations in a deployed environment was also identified as a problem area due to the causes cited above.

This area still does not meet requirements. There have been improvements in the past two years, but they are insufficient to meet the formal requirements of the ORD. A comprehensive program to test and install new and improved LO materials, improve repair processes, reduce cure times, and develop new diagnostic tools has begun. Only a few of these improvements have reached the operational unit. Those improvements, coupled with better management of LO maintenance, have led to only a moderate increase in mission capable rates.

Mission Capable Rate during FY00 has averaged about 39 percent, compared to the ORD requirement of 60 percent. Although this is better than the 32 percent experienced in FOT&E, the improvement is not statistically significant and the most recent six months have seen a decline back to about 33 percent. Factors contributing to this recent decline include manning issues and technical issues (e.g. aft deck cracks, nozzle bay doors, windshield tape, and over-G technical data shortcomings) impacting overall LO maintainability and aircraft availability. If LO maintenance is not included in the MCR calculation, the FY00 rate was 71 percent, declining to 68 percent for the past six months. The using command, Air Combat Command, has recently reduced their standard for B-2 MCR to 50 percent (including LO) and 80 percent (not including LO; no ORD requirement exists for MCR without including LO).

Sortie Generation Rate for deployed operation has not been measured directly. However, turnaround times seen in training missions and during OAF indicate that the ORD requirement is unlikely to be met.

Mission Survivability: The Defensive Management System (DMS) is still unsatisfactory. However, in IOT&E and FOT&E, AFOTEC assessed the B-2 as being survivable against the projected threat on the assumption that appropriate mission planning, force packaging, and tactics are employed.

Force Development Evaluation survivability testing in FY00 was focused on evaluating improvements to DMS. DMS is designed to identify and locate unknown threats that pop up during a mission. During earlier testing the DMS was found to be operationally unsatisfactory. Problems included inaccurate information, a cluttered display, and an excessive workload to operate the system.

Cumulative changes to the operational software have corrected a number of DMS deficiencies found during IOT&E. The most recent software release (P1.1) and changes to the Mission Data File (MDF) have led to reduction of false detections and improvement in identification and location performance. However, the system still does not meet all requirements and a large list of deficiencies remain uncorrected. Analysis of operational test results is still incomplete, and training on the new software has been impeded by a lack of test range access. There is no current plan or funding identified to enhance the B-2 DMS further. Although DMS does not provide the originally planned capability, the Air Force indicates the system's deficiencies do not prevent planning and executing B-2 missions.

Weapons Effectiveness: Weapon delivery effectiveness is satisfactory. However, the total weapon delivery rate of the B-2 has been constrained by Mission Capable Rates and Sortie Generation Rates. The B-2's weapon delivery accuracy partially compensates for shortfalls in Sortie Generation Rate and deployability (see below), but the full target kill potential of the B-2 has yet to be reached.

Testing of the B-2 indicates that all requirements for carriage and release of nuclear and conventional weapons have been demonstrated, except for JSOW, which is still undergoing test. Accuracy requirements have been met for all conditions except for high-altitude retarded releases and releases not employing GPS. During OAF, the B-2 confirmed it is a highly accurate bombing platform that exceeds expectations for JDAM weapon delivery accuracy.

In development testing, four JSOWs have been released from the B-2. These launches revealed a number of anomalies with B-2 software and data transfer to the missile. Two of the JSOWs did not achieve required accuracy. However, the most recent launch in September 2000 appears to have been successful and accurate.

Reliability, Maintainability, and Deployability: This area is still unsatisfactory because of poor LO material reliability/durability and poor LO maintainability. In IOT&E, AFOTEC rated this area as not meeting user requirements because the reliability of the LO system was unsatisfactory and the amount of maintenance effort to sustain the aircraft (all systems) was excessive. The most significant limitation was LO maintainability. A large number of B-2 LO unscheduled maintenance events, combined with the lengthy time and excessive manpower required to repair LO discrepancies, reduced aircraft availability. Additionally, the curing of LO materials was a major determinant of the time it takes to complete LO maintenance action. These materials include sealants (used to fill gaps between panels), adhesives, and tapes to cover the joints.

B-2 deployability also did not meet requirements. The B-2 must be able to deploy to forward locations to reduce transit times and achieve a high sortie rate. The capability to deploy was not demonstrated in IOT&E. Obstacles to deployment included the requirements for extensive support equipment, the need to protect the aircraft from rain intrusion, and a requirement for environmentally controlled shelters for use during LO maintenance at deployed sites. In the FOT&E period, deployability capabilities were partially demonstrated by small deployments to Andersen AFB, Guam. These deployments showed that aircraft shelters and extensive support equipment (e.g., ground power and air conditioning units) will be required to support deployed operation.

Force Development Evaluation assessment during FY00 shows that some aspects of maintainability have improved significantly, although still falling short of requirements in some areas. LO maintenance still has the greatest impact. Total Maintenance Man-Hours per Flight Hour (MMH/FH) are now 53, compared to 120 in IOT&E and 73 in FOT&E. Some of the improvement since IOT&E has resulted from a change in the way in which maintenance man-hours are calculated. LO MMH/FH represent 38 percent of the total.

A serious LO maintainability concern is that maintainers still cannot be certain their repairs are effective in returning aircraft radar signature to required levels. A high percentage of aircraft sent to the test range are found to exceed the required radar cross-section. In part, this is because there are no diagnostic tools available to the organizational level maintenance team to verify repairs. A program has been initiated to acquire LO Verification Equipment (LOVE). However, no improvement has occurred in availability of LO verification tools in the past year.

Extensive changes to LO materials and techniques are being introduced on the B-2 in order to reduce repair times. Expectations are high for the Alternate High Frequency Materials (AHFM) program. This program replaces conductive tape surface treatments with sprayed magnetic radar absorbing material. This change is expected to eliminate or reduce repair times for extensive areas of the aircraft. AHFM flight testing was recently completed and data reduction is being accomplished.

Overall reliability of B-2 sub-systems has not improved significantly. The Mean Flying Hours Between Unscheduled Maintenance are now 0.22, compared to the ORD requirement of 0.31 and values of 0.23 and 0.27 observed in IOT&E and FOT&E, respectively. Reliability of critical systems has improved slightly as demonstrated by the Break Rate, which counts the number of mission-essential system failures in 100 sorties. Break rate is now 7 percent, compared to 12 percent in IOT&E and 10 percent in FOT&E.

Deployability has not yet been operationally assessed. Delivery of the first deployable shelter for evaluation has slipped to November 2000. This will be a prerequisite to further deployment testing, at which time additional deployability capabilities (e.g., support equipment, spares) need to be evaluated. No deployment tests are planned within the next year.

CONCLUSIONS

Improvements to the B-2's effectiveness and suitability continue to occur slowly over time. As a result, DOT&E's assessment has changed little since last year. As demonstrated in Operation Allied Force, the aircraft has proven to be an effective delivery platform for precision-guided munitions. Based on DOT&E's review of battle damage assessment reports furnished by the U.S. Air Force Europe Warrior Preparation Center, the B-2 with JDAM demonstrated the highest rate of target destruction of any aircraft/weapon combination used in the war. Once it has been successfully launched it can reliably reach and attack targets anywhere in the world.

In the past year, testing has revealed improvements to mission planning, terrain following, and non-LO maintainability. However, many areas still need improvement: LO maintenance, LO verification, Defensive Management System, Mission Capable Rate, and deployability. Operation Allied Force highlighted these deficiencies as well as some additional upgrade needs (e.g., secure voice and data communications and autothrottles). Because of these issues, the Air Force has postponed declaration of B-2 full operational capability.

A continuing program of OT&E will be required to assess further improvements and sustainment upgrades planned over the forthcoming years. Major advancement is not expected until LO improvements and shelters are delivered and tested, and deployabilty is attained.

C-130 AIRCRAFT MODERNIZATION PROGRAM (AMP)

Air Force ACAT ID Program		**Prime Contractor**
Total Number of Systems:	519	N/A
Total Program Cost (TY$):	$4.9B	
Full-rate production:	FY06	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The purpose of the C-130 Avionics Modernization Program (AMP) is to lower the cost of ownership of the U.S. military's C-130 fleet, including Special Operations Forces (SOF) and other special mission variants, while complying with the Air Force Navigation and Safety (Nav/Safety) Master Plan, Required Navigation Performance (RNP) requirements, and other applicable Global Air Traffic Management (GATM) requirements. This will be done through a comprehensive cockpit modernization of the C-130 fleet by replacing aging, unreliable equipment and adding additional equipment necessary to meet Nav/Safety and GATM requirements. Replacement/addition of equipment is intended to lower the overall cost of ownership of the entire C-130 fleet by reducing cockpit crew manning while simultaneously increasing aircraft reliability, maintainability, and sustainability. The AMP should reduce the number of different aircraft configurations and provide an improved precision airdrop capability for the combat delivery fleet. Additional equipment needed to meet Night Vision Imaging System (NVIS) requirements and improve the C-130's precision approach and landing capability will also be installed. This program also provides the interfaces necessary to integrate real time information in the cockpit.

This modification supports the CINCs' theater airlift requirements to provide air movement and delivery of personnel and equipment directly into objective areas through airland, airdrop, or other delivery techniques. It encompasses the air logistic support of all theater forces, including those engaged in combat operations, to meet specific theater objectives. In addition to combat delivery aircraft, the AMP is designed to support special mission requirements performed by U.S. Air Force C-130 variants, such as the AC-130H/U, EC-130E/H, HC-130N/P, LC-130H, and MC-130E/H/P. Sister Service variants such as the U.S. Navy C-130s, KC-130s, LC-130s, and TC-130s; U.S. Marine Corps KC-130s; and U.S. Coast Guard HC-130s could also benefit from these modifications.

The C-130 AMP supports the ***Joint Vision 2020*** operational concepts of ***dominant maneuver*** and ***focused logistics***.

BACKGROUND INFORMATION

The AMP Requests For Proposal was released earlier this year. Four proposals were submitted, and they are currently being evaluated in source selection. The C-130 AMP Milestone II decision is scheduled for February 2001.

The C-130 AMP Development System Manager, ASC/GRM, is responsible for accomplishment of all tasks to develop, integrate, test, field and support modifications to Air Mobility Command (AMC), Air Combat Command (ACC), and AFSOC C-130 aircraft. A C-130 AMP/Common Avionics Architecture for Penetration (CAAP) Test Planning Working Group has been established to provide a forum for all cognizant test organizations to participate in the C-130 AMP/CAAP test planning process. The Responsible Test Organization (RTO) for AMP/CAAP Developmental Test & Evaluation is the 418th Flight Test Squadron at Edwards AFB, CA. The using commands and AFOTEC will provide crew members, as required, to support ground and flight tests during combined DT/OT and dedicated OT&E. The RTO is responsible for conduct of DT&E testing, detailed test planning, and reporting of test results to the Program Managers. Participating Test Organizations include but are not limited to the 339th Flight Test Squadron (FLTS) at Robins AFB, GA, and Det 1 of the 46 Operations Group at Hurlburt Field, FL. ASC/GRM will manage the LFT&E program.

OT&E will be conducted by AFOTEC, with support from the program office and the using commands. DT&E and OT&E test objectives and sorties will be combined to the maximum extent possible. Force Development Evaluations may be conducted by the Air Mobility Command's, 33rd FLTS and by the Air Force Special Operations Command's 18th FLTS beginning in FY03.

TEST & EVALUATION ACTIVITY

DOT&E has participated in the IPTs that review preparations for the Milestone II decision. Test Planning Working Groups have been held to clarify important details of the TEMP, and a LFT&E IPT has been created to formulate the specifics of the LFT&E program.

The AMP test strategy presumes that contractor ground tests will be conducted at the modification facility yet to be determined. Following a series of shakedown flights at the contractor facility, the aircraft will transition to the RTO facility at Edwards AFB for the start of formal DT&E. DT&E flight tests will be accomplished by a combined government and contractor Integrated Test Team under the direction of the RTO. AFOTEC personnel will participate as part of the government contingent.

TEST & EVALUATION ASSESSMENT

The successful integration of AMP components across a broad range of aircraft configurations and mission requirements will be a significant challenge. The concept is feasible, however, it is unlikely to succeed unless the various users commit to a unified fleet management approach for the modification of all aircraft. Fleet management of more than 700 aircraft is one of the keys to success. A tentative plan calls for some aircraft being retired, others being moved from one unit to another to mange structural life, some sent to depot, and still others used for test purposes. Identifying aircraft by tail number, without regard to unit ownership, is efficient, but it is not popular. Unity of purpose and strong leadership by all affected commands will be vital over an extended period of time.

The following lists the different Mission Design Series (MDS) of the C-130's to be modified and some of the special test requirements for them:

Quantities of C-130 and Special Test Requirements by MDS

MDS	Nomenclature	Special Tests
C130E/H/H1/H2/H3	Combat Delivery	GATM, TCAS, TAWS, NVIS, FMS
AC-130H/U	Gunship	Gunfire Accuracy, ESA, Defensive
EC-130E	ABCCC	Mission Unique
EC-130H	Compass Call	Mission Unique
HC-130N/P	Combat Rescue	Mission Unique
MC-130E	Combat Talon I	TF/TA Navigation
MC-130H	Combat Talon II	TF/TA Navigation, ESA, Defensive
MC-130P	Combat Shadow	Mission Unique
LC-130H	Ski	Mission Unique

The request for proposal to execute this program allows the winning contractor to determine how each MDS will be modified to meet requirements. This allows for the possibility of different configurations for each MDS. The potential gains in fleet commonality may not be realized and the impacts on training, interoperability, and logistics could lower combat effectiveness. However, a standard cockpit layout is planned allowing crewmembers to be trained to fly in one MDS and only required to undergo mission qualification when reaching their new units—unlike the current situation.

C-130J AIRLIFT AIRCRAFT

Air Force ACAT IC Program		**Prime Contractor**
Total Number of Systems:	37	Lockheed Aero
Total Program Cost (TY$):	$4.8B	
Average Unit Cost (TY$):	$73M	
Full-rate production:	N/A	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The C-130J Hercules II is a medium-range, tactical airlift aircraft designed primarily for the transport of cargo and personnel within a theater of operations. The cargo area can adapt to accommodate a combination of passenger, cargo, and/or aeromedical airlift missions. Variants of the C-130J will perform missions such as psychological operations (EC-130J), weather reconnaissance (WC-130J), and aerial refueling (KC-130J).

The C-130J retains many structural characteristics of the C-130H, having the same overall interior/exterior dimensions. However, the C-130J is more than 70 percent unique, relative to previous models. Significant differences include an advanced integrated digital avionics system, a re-designed flight station intended to facilitate a two-person cockpit, a new propulsion system intended to provide improved take-off, climb and cruise performance, and cargo compartment enhancements.

The C-130J supports the concepts of ***dominant maneuver*** and ***focused logistics*** for ***Joint Vision 2020***.

BACKGROUND INFORMATION

The C-130J aircraft is a contractor-initiated improvement upon the C-130H-3. The United Kingdom, Australia, and Italy have purchased variants of the C-130J design. Creation of a C-130J acquisition program within DOD was directed to provide U.S. Air Force oversight of aircraft development. The C-130J aircraft procurement is proceeding under a commercial acquisition strategy.

Contractor DT&E commenced in spring 1996 and will likely continue through CY03. DT&E has focused on the satisfaction of aircraft requirements defined in the Model Specification. Government Qualification Test and Evaluation (QT&E) has occurred in two formats. Initially, it evaluated designated military utility issues at Edwards AFB in March 1998. Subsequently, a Follow-On Test Program was established by the Air Force to permit evaluation of incremental development progress as well as formation airdrop, the towed-parachute retrieval system, defensive systems, and survivability. These additional tests will be conducted prior to the commencement of the next phase of Qualification Operational Test and Evaluation (QOT&E). QOT&E Phases are called 1A, 1B and 2, and they correlate, with mission software versions 5.1, 5.2, and 5.3 respectively. In August 1999, the Air Force Flight Test Center completed qualification testing of mission computer software version 5.1. This software enables basic airland functions, excluding assault landings and unimproved runway operations. Operational testing with version 5.1 resulted in a limited operational capability release for conversion training only.

DOT&E designated the C-130J aircraft for LFT&E Oversight in May 1995. In March 1998, the Director of OT&E and the Assistant Secretary of the Air Force agreed to a LFT&E program that addresses wing dry bay fire, composite propeller ballistic vulnerability, wing fuel tank hydrodynamic ram effects, engine and engine bay fires, vulnerability to man-portable air defense systems threats, and mission abort vulnerability. The agreement established a joint DOT&E/Air Force C-130J LFT&E program that takes advantage of testing and evaluation under both the DOT&E funded Joint Live Fire (JLF) program for the C-130E/H and the Air Force funded C-130J [LFT&E program] vulnerability reduction program. The JLF program addresses potential vulnerabilities of wing fuel tanks to hydrodynamic ram impact and mission abort vulnerability. A TEMP describing the program was submitted to and approved by DOT&E in July 1999.

DOT&E also designated the U.S. Marine Corps KC-130J aircraft for LFT&E Oversight in January 2000 under the title, C130J (ALL VARIANTS).

The Federal Aviation Administration (FAA) awarded Lockheed Martin a Type Certificate for a commercial version of the C-130J-30 aircraft (a stretch model designated as the 382J, which currently exists only on paper) on September 9, 1998. However, significant C-130J and C-130J-30 military requirements are not included in the FAA certification. This necessitates additional testing by the Air Force and other U.S. government users.

TEST & EVALUATION ACTIVITY

Qualification testing for mission software Version 5.2 was completed in June 2000, and qualification testing for Version 5.3 is tentatively scheduled to start in spring 2001. Operational testing of Version 5.2 began in August 2000 and was completed in September 2000. Operational testing of Version 5.3 is scheduled for spring 2002.

On June 14, 2000, the Program Executive Officer for Airlift and Trainers certified the C-130J as ready to commence Phase 1B (airland) QOT&E with limitations. The AFOTEC Commander reviewed that certification plus the analyses and recommendations of his staff before concurring with the recommendation to start QOT&E. The Director, Operational Test and Evaluation considered total developmental progress as well as AFOTEC's three-phase OT program before approving the recommendations to proceed.

C-130J LFT&E program activities included preparation of detailed reports on the results of the wing dry bay vulnerability testing that was completed in FY99, preliminary planning for the composite propeller ballistic vulnerability testing, and planning and conducting wing fuel tank hydrodynamic ram vulnerability tests. The Air Force is coordinating the propeller Live Fire test activity with the U.S. Marine Corps since a similar propeller design is used on their landing craft-air cushion vehicle. Two C-130H left wing assemblies were subjected to ballistic testing to evaluate hydrodynamic ram damage. The test series consisted of fourteen shots with several different representative threat projectiles into the wing fuel tanks at potentially critical locations. C-130 Aircraft Battle Damage Repair (ABDR) technicians from Robins AFB and an ABDR engineer were on-site during the testing to assess damage and repair the test article for each successive shot.

KC-130J LFT&E program planning was initiated in FY00. The focus of activities was the identification of KC-130J LFT&E issues and the scope of required testing. The intent is to leverage as much information as possible from other C-130J LFT&E tests and analyses and to define a reasonable program that addresses KC-130J's unique design and operational characteristics.

In FY00, DOT&E and the Air Force initiated a C-130 fleet-wide evaluation of potential LFT&E issues. This initiative came as a result of preliminary findings on the results of the dry bay fire tests and recognition that these findings apply to all models of the C-130. The initial planning meeting was held in August 2000 and focused on identification of C-130 fleet LFT&E testing, applicable modeling and simulation, planned modeling and simulation, issues of LFT&E, and plans to address voids in C-130 fleet LFT&E.

TEST & EVALUATION ASSESSMENT

Issues confronting the C-130J program have included logistics support and training systems funding; delayed FAA certification; hardware, software, and technical order deficiencies; manufacturing quality, sub-system reliability, failure to meet required measures of system effectiveness and suitability, lead command responsibilities, resolution of documented deficiencies, schedule credibility, and parallel development of numerous variants to the basic platform.

These issues will continue to affect the program as it progresses through developmental testing and moves toward Phase 2 of operational testing and concurrent delivery of aircraft to selected users undergoing unit conversion training. Operational capabilities will be limited for the foreseeable future.

The overriding shortfall has been in software development and integration. A second critical issue impacting both OT&E and user implementation has been the lack of funding for logistics support and training systems. Future logistics shortfalls will likely render the C-130J "not operationally supportable." Interim contractor support, reparable items, logistics and maintenance data, and maintenance training will all be degraded. These shortfalls will limit operational deployment of the C-130J.

Numerous aircraft deficiencies were discovered during QT&E. Multiple software anomalies within the communication/navigation/identification computer, affecting both logic and integration, impact navigation and preclude automatic (hands-off) airdrop. Lockheed structural limitations have prevented safety certification of paratroop retrieval system hardware. Consequently, the capability to retrieve hung jumpers is uncertain. Lack of a continuous sideslip indicator has also been a problem. These anomalies adversely impact airland and airdrop operations, as well as aircrew workload during mission planning, pre-flight and in-flight operations. Other aircraft restrictions limit cargo loading and unloading.

The ongoing identification of deficiencies, as well as the extent and timeliness of corrective actions, has become a concern during QOT&E. In light of the numerous deficiencies reported by government and contractor test teams, three major upgrade phases involving hardware and software are planned by Lockheed Aero to bring the aircraft into system specification compliance. These upgrades will address more than 50 deficiencies, with precedence given to the most critical deficiencies where possible. The relevance and potential impacts of these deficiencies was assessed throughout Phase 1B of QOT&E and subsequent tests.

The C-130J TEMP was approved by DOT&E on July 29, 1999. Development of a comprehensive test strategy was delayed, in part, by the uncertain program structure and deployment objectives. Operational test programs to examine variant configurations (WC-130J, EC-130J, and KC-130J) and their associated missions are currently under development and review. The KC-130J TEMP is in final draft. The C130J-30 TEMP is in work.

Phase 1B testing ended in September. Based on the results evaluated in Phases 1A and 1B, AFOTEC determined the aircraft not operationally effective for the airland mission. Aircrew workload issues, software discrepancies, cargo loading and cargo constraint requirements were major contributors. The using command is unable to verify manpower requirements to field this system until the crew workload evaluation is complete. That evaluation will not be conducted until airdrop capabilities are delivered in version 5.3, tentatively spring 2002.

In addition, AFOTEC determined the aircraft not suitable. The reliability, maintainability, availability, and logistics supportability demonstrated during Phase 1B were below operational requirements. Deficiencies were noted with on-aircraft integrated diagnostics and fault isolation systems, portable maintenance aids, maintenance technical orders, and availability of spare parts. Additional contractor field service representatives will be required to assist in the maintenance of the aircraft for the foreseeable future.

Based on the results of this testing, the using command will determine the specifics to an interim operational capability release in December 2000.

Preliminary evaluation of C-130J wing dry bay test results indicate that wing dry bay vulnerabilities exist in the C-130J and that fire detection and extinguishing systems using reasonable masses of pentafluoroethane (HFC-125) or solid propellant gas generator (SPGG) extinguishant could be designed to alleviate these vulnerabilities.

Detailed damage definitions for each wing hydrodynamic ram shot were documented and sent to Lockheed Martin, the C-130J prime contractor, for analysis of post-shot residual strength and remaining flight capabilities. Results of these analyses will be published in FY01.

Realistic, production-representative test articles for C-130J LFT&E wing dry bay fire tests and wing fuel tank hydrodynamic tests were constructed from C-130H aircraft.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

The AFOTEC test team continued to play a significant role in the C-130J program. In accordance with the approved operational test plan, the test team demonstrated that the system is not mature and is neither effective nor suitable to perform airland operations. To ensure operational realism, the operational test plan did not allow the use of maintenance personnel not identified in the maintenance concept of operations. Although contractor Field Service Representatives (FSRs) were available for problem resolution, and the use of FSRs may have expedited the correction of deficiencies and increased the aircraft availability rate, deficiencies with the maintenance manuals, support equipment and integrated diagnostics (i.e., BIT) would not have been highlighted. Until these deficiencies are resolved, the Air Force will require an elevated FSR presence to assist with aircraft maintenance.

Block 5.3 functionality is intended to provide the user with the required combat delivery capability; however, completion of the "spec compliant" software has been repeatedly delayed. Reasons for the delays include an exodus of technical personnel, including software specialists on the Ground Based Data System (logistics) team and management. Also, due to the number of different customers, conflicting priorities have arisen which has shuffled resources throughout the program—resulting in the current delay.

Based on the C-130J LFT&E dry bay fire testing, careful consideration should be given to installing fire detection and extinguishing systems to alleviate identified vulnerabilities.

LFT&E programs can benefit from participation of BDAR personnel who quickly and economically repair test articles for subsequent shots. In addition, the ABDR personnel get exposure to realistic combat damage and training for damage assessment and application of aircraft repair techniques.

I continue to be concerned about the potential vulnerability of this aircraft to fire and explosion from impacts into the wing dry bays and several other large presented areas of the aircraft. We have had extensive discussions with the Air Force and the Under Secretary of Defense (A,T&L) on this issue and we have reached agreement that this is indeed a vulnerability which the Air Force must fix.

C-17 GLOBEMASTER III AIRLIFT AIRCRAFT

Air Force ACAT IC Program		**Prime Contractor**
Total Number of Systems:	134	Boeing
Total Program Cost (TY$):	$45,043M	
Average Unit Cost (TY$):	$232M	
Full-rate production:	1QFY96	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The C-17 is a four-engine turbofan aircraft capable of airlifting large payloads over intercontinental ranges without refueling. It is intended to allow delivery of outsize combat cargo and equipment directly into austere airfields. The C-17 is required to deliver passengers and cargo between continents, provide theater and strategic airlift in both airland and airdrop modes, and augment aeromedical evacuation and special operations missions.

Significant features of the C-17 include: supercritical wing design and winglets to reduce drag; in-flight refueling capability; externally blown flaps; direct lift control spoilers; high impact landing gear; a forward and upward thrust reverser system that provides backup capability; a cargo handling system that permits operation by a single loadmaster; a two-person cockpit; and maximum use of built-in test equipment to reduce maintenance troubleshooting times.

The C-17 supports the ***Joint Vision 2020*** operational concepts of ***dominant maneuver*** and ***focused logistics***.

BACKGROUND INFORMATION

IOT&E of the C-17 was conducted in four phases from May 1992-June 1995. Based upon results of IOT&E and live fire testing, DOT&E submitted an Operational and Live Fire Test and Evaluation Report (B-LRIP) to Congress in November 1995. The report assessed the operational effectiveness and suitability of the aircraft to conduct operational missions within the context of the existing airlift system. The C-17 was judged to be operationally effective (with limitations) and operationally suitable. Survivability was not sufficiently evaluated to make an assessment. A full-rate production decision, Milestone IIIB, was made in November 1995.

A three-year initial period of FOT&E commenced in June 1996. It was conducted by the Air Mobility Command (AMC), with management by the Headquarters, Test and Evaluation Directorate, Scott AFB, IL, and test execution by the Air Mobility Warfare Center's Flight Test Squadron (33 FLTS) at McGuire AFB, NJ, utilizing a detachment (Det 1) stationed at the test location, Charleston AFB, SC. The primary FOT&E objectives included completing tests deferred from IOT&E, developing and refining employment procedures and tactics, and addressing IOT&E deficiencies.

A major observation from IOT&E cited deficiencies associated with personnel airdrop, including equipment and procedural shortcomings. Specific areas requiring further evaluation during FOT&E included exit rate for static line personnel drops, combination paratrooper and bundle drops, and development/refinement of personnel airdrop formations.

The C-17A completed LFT&E in 1994. Since the completion of that testing, two major structural modifications have been incorporated that may require further LFT&E. The horizontal tail has been changed to a composite material construction, and an extended range fuel containment system has been added in the center-wing area of the fuselage. These changes could significantly affect aircraft survivability. Furthermore, based on the total cost of these changes, the upgrades could constitute a new program since their costs exceed that of a major system development. DOT&E has initiated a review of all changes made to the C-17 since the B-LRIP report was published in November 1995.

TEST & EVALUATION ACTIVITY

Initial FOT&E, which commenced in FY96, concluded in FY99. Detachment 5, AFOTEC, Edwards AFB will support continuing OT&E. Similarly, future DT&E by a combined Boeing and U.S. Air Force team at Edwards AFB will focus on aircraft modifications and upgrades.

Most of the sub-standard items identified in IOT&E have been closed. This includes "deficiencies" (did not meet Operational Requirements Document (ORD) criteria), "inadequacies" (qualitative assessment that failed), "recommendations" (met criteria but had problems which could be improved), and "deferrals" (test not accomplished during IOT&E). Although all deficiency items are considered closed, fault isolation procedures/manuals and built-in test equipment require improvements, and the Strategic Brigade Airdrop mission has operational limitations. Efforts to include dual row cargo/equipment airdrop are in progress to shorten the drop zone delivery time.

One high visibility FOT&E item still in progress is an improvement to the On-Board Inert-Gas Generating System (OBIGGS). A reliability improvement program on OBIGGS was completed; changes are being incorporated but have not been operationally evaluated at this time. Funding for a new OBIGGS program is being considered for FY03.

The C-17 passed the 214,000 flight-hour mark in August 2000. The Mission Capable (MC) and Fully Mission Capable (FMC) measures have been tabulated. Results of both measures, presented as a range of monthly averages over three different measurement periods, are shown below, together with standards from the 1993 ORD and the 1998 ORD.

C-17 Flight-Hour Mission Capable (MC) and Fully Mission Capable (FMC) Rates

Measured Values

	Jun 93-Aug 95	Sep 95-Aug 97	Sep 97-Sep 99	Oct 99-Sep 00
MC	30.5-83.5%	75.7-93.0%	81.7-91.1-%	78.6-85.9%
FMC	0-74.4%	7.8-75.0%	41.6-71.5%	37.6-64.3%

Standards

	1993 ORD	1998 ORD	AMC FY98 Standards
MC	82.5%	90.0%	87.5%
FMC	74.7%	80.0%	77.5%

Notes: Standards for MC are "threshold" (minimum acceptable) values while FMC standards are deemed "objective" values (goals).

Demonstrated values for MC surpassed the 100,000 flight-hour standard specified in 1993; however, the standard was increased in the 1998 ORD when higher rates appeared attainable. The MC rate hovered near 90 percent in 1997 before spare parts shortages and increasing depot maintenance caused it to drop. The measures for FMC, although well below the 1993 and 1998 ORD objectives, were initially trending upward, however due do recent failures of some key components, the trend has reversed. The Head-Up-Display (HUD), OBIGGS, the main landing gear, fuel system fittings, and navigation system software have impacted FMC. Extensive downtime has been attributed to a lack of equipment to re-boresight and realign HUD mounting trays, high failure rates for OBIGGS components, lack of durability in main landing gear parts, and inadequate integration of Global Positioning System (GPS) and inertial reference unit software. An OBIGGS improvement program is being considered for FY03. A HUD alignment program is in work. Landing gear durability tests are underway, and design changes are anticipated. New navigation software is being developed and tested.

Developmental Test and Evaluation will continue at Edwards AFB under the heading of the Follow-On Flight Test Program (FOFTP). AFOTEC-Det 5 at Edwards AFB will maintain involvement through ongoing communication with the Program Office and the C-17 Test Team resident at Edwards AFB.

TEST & EVALUATION ASSESSMENT

The apparent limited capability for dual-row airdrops (release of two rows of cargo platforms positioned side-by-side in the aircraft) may necessitate sequential (side by side) release of rather than simultaneous release of the special 88-inch wide by 16-foot long platforms to prevent collisions after they exit the aircraft. The resultant effect is an increase in delivery time and required drop zone length; however, the total number of aircraft required to drop equipment for a brigade has been significantly reduced. At present, the combined effects of dual-row airdrop and aircraft spacing for personnel drops have positively impacted the strategic brigade airdrop execution time, which is getting nearer to the Army's goal.

The Program Office is revising the TEMP to better address continuing flight tests, particularly the Follow-On Flight Test Program at Edwards AFB and continued operational testing by the 33 FLTS at McGuire AFB. The current TEMP was approved in 1995, and contained substantial information on FOT&E. A revised TEMP will better address FOFTP at Edwards AFB and operational testing by AFOTEC and the 33 FLTS. In addition, an updated OT test plan will be submitted. The updated plan will focus on the transfer of OT management responsibility to the 33 FLTS and a more detailed scope of the proposed testing for the next four years. In addition, AFOTEC will have an increased role in future operational testing. The TEMP will also define the future LFT program.

The ARC-210 radio antennas and logic modules were being removed at a high rate because of diode failures not evident in previous components. Retrofit was completed in May 2000. Fuel system power wiring in Block 11 aircraft requires replacement upon delivery. Alignment deficiencies between the Head-Up Display (HUD) and the Inertial Reference Units (IRUs) is a deceptively complex issue that precludes safe assault landings on short airfields. In addition, Block 10/11 aircraft (one-third of the current fleet) were initially fielded IRU/GPS/MC software that experience navigation accuracy problems restricting aircraft to CONUS-only flight. The fix to CONUS restrictions is being evaluated. Root cause for the landing gear post problem is still being examined.

Regarding planned upgrades, Block 12 (which includes the extended range fuel tank and several Global Air Traffic Management functions) will be the most significant configuration change yet. Block 12 aircraft should begin delivery in February 2001. They will contain 280,000 different lines of software, and 33 percent of the line replaceable units will be different. A two-phase implementation (Blocks 12- and 12+) is being proposed. Block 12 software and sub-systems modifications appear to be more complex than Block 10, which produced an inordinate number of operational difficulties. Blocks 10/11 lacked appropriate spares, technical orders, and training for flight and ground crews. Problems are currently being addressed. With more key modifications and enhancements planned for Blocks 13 and 14, the need for OT&E to ensure the delivery of effective/suitable systems continues to increase.

Challenges to developmental and operational flight testing in 2001 and beyond include constraints to individual project budgets, test resources, and aircraft availability for test. Only a single dedicated aircraft exists for developmental flight testing. Requests for flight test time on operational aircraft are in stiff competition with high operational mission demands. Also, the large number of aircraft scheduled for modification has limited the available aircraft to perform mission requirements and testing. These challenges have affected the depth and duration of testing conducted following aircraft modification and upgrade.

CONCLUSIONS

A large measure of the C-17's documented operational success is attributable to T&E decisions by DOT&E and DEPSECDEF during EMD. At the same time, deficiencies identified during IOT&E still remain; i.e., OBIGGS. When prior deficiencies are combined with operational effectiveness and suitability problems identified since the C-17 Reliability, Maintainability and Availability evaluation, it appears that greater resource allocations for deficiency correction and enhanced T&E priority after Milestone IIIB could have reduced or eliminated many current troubles.

In addition, policies and procedures flowing from the push toward commercial acquisition are leading the C-17 down a risky path. A lack of fiscal, technical, and testing realism may be creating fleets that cannot meet effectiveness, sustainability, or interoperability requirements. In the case of the C-17, data suggest that no more than three aircraft on any base are in the same configuration. This negatively impacts the logistics supportability and availability of the fleet. Moreover, the partially mission capable rates are now consistently below the command standard, and aircraft availability (because of constant modification) has become a significant issue.

C-5 RELIABILITY ENHANCEMENT AND RE-ENGINEERING PROGRAM (RERP)

Air Force ACAT ID Program		**Prime Contractor**
Total Number of Systems:	126	Lockheed Aero
Total Program Cost (TY$):	$6B	
Average Unit Cost (TY$):	$45-55M	
Full-rate production:	FY05	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The current C-5 fleet operates throughout the Active, Reserve, and National Guard components in various missions and environments. C-5 missions include strategic airlift, emergency aeromedical evacuation, airland of a brigade-size force in conjunction with other organic aircraft, transport of outsize and oversize cargo, and multi-ship Special Operations Low Level II. The C-5 aircraft must perform missions at night and in adverse weather, and it may employ aerial refueling during intercontinental missions.

The C-5 Reliability Enhancement and Re-engining Program (RERP) will dramatically change the aircraft propulsion system. It will integrate commercial engines, nacelles, thrust reversers and pylons into the existing C-5 airframe. These performance improvements will optimize cargo carrying capabilities, allowing fully loaded take-offs and landings on relatively short runways, and will allow the C-5 to meet the performance requirements of the Global Air Traffic Management initiative. Additionally, re-engining is expected to provide significant Reliability, Maintainability and Availability improvements. A commercial engine support concept (two levels of maintenance, warranties, power by the hour, etc.) will be integrated into the C-5 logistics support system infrastructure.

Other candidate sub-systems for reliability enhancement include the flight controls, hydraulics, environmental, electrical, and fuel systems. Specific upgrades and the extent of the expected reliability improvement will be identified during the trade studies planned in FY01.

The C-5 was developed and procured prior to the implementation of LFT&E statutory requirements. Therefore, the basic aircraft has never completed a live fire evaluation. The RERP modification is an ACAT I program and constitutes a covered program for LFT&E. (Note - The January 2000 Oversight List designated C-5 RERP for DT and OT oversight but not for LF.)

Lockheed Martin is the prime contractor and has overall integration responsibility. Lockheed selected General Electric as the power plant subcontractor and BF Goodrich as the pylon subcontractor. The C-5 RERP supports the concepts of ***dominant maneuver*** and ***focused logistics*** for ***Joint Vision 2020***.

TEST & EVALUATION ACTIVITY

A TEMP is being developed to support a Milestone II decision for the C-5 RERP in December 2000. No QT&E or OT&E has been conducted to date. Only preliminary test planning has occurred thus far. DOT&E has been an active participant in the development of the TEMP, in the review and revision of the acquisition strategy, and in the DOD IPT process.

Fiscal Year 20000 LFT&E activity focused on identifying potential LFT&E issues, developing an LFT&E strategy, and updating the TEMP to incorporate LFT&E requirements. To support development of the LFT&E strategy, the Air Force is conducting modeling and simulation. Several models are being used, namely, FASTGEN (Fast Shotline Generator), COVART (Computation Of Vulnerable Area and Repair Time), MOSAIC (Modeling System for Advanced Investigation of Countermeasures), SPIRITS (Spectral and In-band Radiometric Imaging of Targets and Scenes), and FISTA (Flying IR Signatures Technology Aircraft). Submittal of a draft updated TEMP with a LFT&E strategy is expected in early FY01 following the Milestone II decision. We will support a request for a waiver from full-up, system-level testing since testing a complete, combat configured system would be unreasonably expensive and impractical. We anticipate that an adequate alternative LFT&E plan will be developed.

TEST & EVALUATION ASSESSMENT

The schedule risk for the C-5 RERP development and test programs is moderate to high. The C-5 RERP test program is dependent on the success of the C-5 Aircraft Modernization Program (AMP), which is avionics and software intensive. Any slip in the C-5 AMP program schedule will impact the schedule of the C-5 RERP since the single engineering and manufacturing development aircraft will be a modified C-5B from the C-5 (AMP) test program. In addition, the current acquisition strategy does not include the modification and test of a C-5A even though there are 76 A-model aircraft (including two special configuration aircraft) and only 50 B-models. Further review of this acquisition strategy is scheduled.

COMBAT SURVIVOR EVADER LOCATOR (CSEL) SYSTEM

Air Force ACAT III Program		**Prime Contractor**
Total Number of Systems:	45,740	The Boeing Company
Total Program Cost (TY$):	$230M	
Average Unit Cost (TY$):	$5K (per radio)	
Full-rate production:	2QFY03	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Combat Survivor Evader Locator (CSEL) system-of-systems is designed to provide downed combat aircrew/isolated personnel with the capability to transmit status and position information rapidly to the appropriate Joint Search and Rescue Center (JSRC) as a means to expedite coordinated rescue/extraction. The CSEL system provides the users with satellite communications, precision Global Positioning System (GPS) geo-location, and line-of-sight voice communications capabilities. The CSEL system provides the combat commanders and their maneuver forces with the ability to ensure rapid location and coordinated recovery of isolated personnel, thereby contributing to ***full dimensional protection*** by means of ***information*** and ***decision superiority***.

The CSEL system consists of newly developed hand-held radios (HHR), CSEL planning computer (CPC) with radio set adapter, unattended Ultra-High Frequency (UHF) base stations (UBS), and software for JSRC workstations. The CSEL system depends upon the existing UHF satellite communication (SATCOM) constellation, Search and Rescue Satellite Aided Tracking (SARSAT) constellation, limited National Assets, GPS satellite constellation, and existing Secret Internet Protocol Router Network (SIPRNET) connectivity to and from the JSRC.

The HHR is capable of generating radio frequency (RF) waveforms for UHF and Very High Frequency (VHF) voice, UHF and VHF data, and select National Asset data communications. It is capable of calculating precision GPS geo-location, and generating swept-tone beacon signals. The voice waveforms are for non-encrypted communications with rescue forces and other HHR operators. The UHF data waveforms are for encrypted, two-way SATCOM linkage to/from the JSRC; encrypted, one-way National Asset linkage to the JSRC; or non-encrypted, one-way SARSAT linkage to the JSRC in global regions above 70 degrees North or South Latitudes. Once calculated by the HHR, the GPS geo-location is transmitted as part of the text in all HHR data transmissions. Other data message content is derived from listings of "canned" messages available from the menu-driven CSEL software. The swept-tone beacon cannot be used without the Personnel Locator System. The physical size and weight of the HHR is not to exceed that of predecessor survival radios.

The CPC is a laptop computer used to pre-program the HHR through the radio set adapter. GPS initialization, flight-plan waypoints, "safe locations," frequencies, and identification information is loaded into the HHR, as necessary, before each sortie. Transmission records and HHR status diagnostics may be extracted from the HHR at the completion of each flight.

Four UBS ground installations are planned for global UHF SATCOM coverage. The UBS receives HHR data transmissions via the SATCOM constellation and relays the data over SIPRNET paths to the appropriate JSRC. Messages generated by the JSRC follow the reverse paths to the HHRs communicating with the JSRC. SARSAT and National Asset constellations have their own dedicated base stations and provide received HHR data over the SIPRNET backbone to the UBS.

The JSRC software, currently hosted on SUN workstations, provides the Joint Forces Air Component Commander with the capability to communicate with the individual HHR operators, plan coordinated rescue/extraction missions, and interface with the Theater Battle Management Core System software package used by the Air Operations Center.

The CSEL program is segmented into two parts. Block I provides the full system without Demand Assignment Multiple Access-Compatible (DAMA-C) user-multiplexed satellite connectivity and without full software interoperability, as defined by Defense Information Infrastructure Common Operating Environment (DII COE), Level 7. Block I provides the system hardware to the users as early as possible in FY01 under LRIP approval. Block II will incorporate DAMA-C and DII COE Level 7 capabilities by mid-FY03 in the form of new software loads to the HHR, UBS, and JSRC workstations and hardware upgrades to the UHF Base Stations.

BACKGROUND INFORMATION

The requirement for a robust survival radio that incorporates GPS geo-location capability was originated by a CINCPAC Mission Need Statement, and later validated by the Joint Requirements Oversight Council on February 4, 1992. The program was approved to enter an 18-month, $30M RDT&E EMD phase in late 1995, and a contract was awarded to Boeing on February 23, 1996. Added requirements for data encryption, DAMA-C connectivity, and DII COE Level 7 interoperability increased the program to 23 months and $57.2M RDT&E by late 1996.

The CSEL program was placed under DOT&E oversight in spring 1998. AFOTEC conducted an EOA of the program from April-July 1998. The assessment (OA1) included observations from combined DT/OT testing at Ft. Huachuca, AZ; shipboard operations on USS *Essex*; participation in a Joint Rescue Exercise (JREX); participation in the Cope Thunder exercise; and participation in seawater and cold weather testing in Alaska. DOT&E observed test activities in JREX, Cope Thunder, and Alaska testing. As a result of deficiencies found in the 1998 OA1, an LRIP decision was not supported and the CSEL program was restructured to include an additional operational assessment (OA2) in late FY00 and Multi-Service OT&E in early FY02. (OA2 is currently scheduled for February 2001, with an MOT&E in mid 2002). Boeing has since been awarded a Total System Performance Responsibility contract; provided design corrections for the bulk of the deficiencies found during OA1, and conducted DT testing on those corrections in September 1999; redesigned the Controller Module, VHF/UHF Module, and software for the HHR; and initiated design of a GPS Selective Availability Anti-Spoofing Module (SAASM). Design defects in the SAASM (CINCO II ship problem and flame-spray processing issue) have resulted in a 4-month delay of the OA2, now re-scheduled for February 2001. OA2 will be conducted on pre-production Block I HHRs to support an LRIP decision for 1,365 HHRs. The program has increased from 18 months to over 72 months, and from $57M-$83M RDT&E due to technical challenges and additional requirements definition.

TEST & EVALUATION ACTIVITY

No OT&E testing was scheduled for FY00. The year has been dedicated to the design and fabrication of SAASM components, Controller Modules, VHF/UHF module boards, and software in the HHR units. Component-level and radio-level tests of the HHR test articles have occurred during the last half of the fiscal year and commencement of DT tests will occur in October 2000. Field testing of the pre-production CSEL system was conducted at Ft. Huachuca from November-December 2000. Operational Assessment 2 is scheduled to occur during February and March 2001 in Hawaii and will support an LRIP decision for the Block I configuration in mid-FY01. MOT&E of the LRIP Block I production articles will occur in late FY02; Block II configuration testing will occur in mid-FY03.

TEST & EVALUATION ASSESSMENT

AFOTEC is monitoring the bench test of CSEL components to ascertain correction of defects identified during OA1 testing. The ORD, which was revised to reflect the Block I and Block II accommodation of the CSEL requirements, was approved on February 29, 2000. The TEMP, which is currently under revision to reflect the program restructure, should be submitted for approval in early CY01. The CSEL program is making positive progress. The CINCs have expressed an urgent need for this system. The program office is focused on delivering an operationally effective and suitable product as soon as possible.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

CSEL is not just a hand-held radio. It is a system that includes a hand-held radio, support equipment to program the HHR, an unmanned base station and a software application for the rescue center. The system relies on many other systems including UHF SATCOM, SIPRNET, National Systems, and GPS to perform its mission. It is crucial for test and acquisition personnel to consider the system, not just the radio.

DEFENSE CIVILIAN PERSONNEL DATA SYSTEM (DCPDS)

Air Force ACAT IAM Program

Total Number of Systems:	325
Total Program Cost (TY$):	$157M
Average Unit Cost (TY$):	$0.5M
Life Cycle Cost (TY$):	$399M
Full-rate production:	2QFY01

Prime Contractor

Air Force Military Personnel Center

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Defense Civilian Personnel Data System (DCPDS) will provide the software application tools and the requisite hardware to support civilian personnel mission requirements for DoD. Its genesis was the regionalization of DoD personnel data centers, with the consolidation of personnel service centers. DCPDS complements regionalization in that the automated tools it provides will facilitate the expected decrease in the personnelist to customer service ratio (from 1:50 to 1:100).

Some aspect of DCPDS will be installed at each level of the hierarchical personnel command chain. The main focus of DCPDS are the Regional Service Centers. They will receive the full DCPDS hardware and software. Other lower levels will receive a portion of the system suite commensurate with the scope of their operations and the willingness of their respective services to commit funds towards the project.

The basic design of the system is a client-server architecture. Data entered into the system at the Customer Support Units will update to the Regional Service Centers. The data base of record for each service's region (and for each DoD agency) will reside at their respective Regional Service Center. The Civilian Personnel Management Service will keep a DoD enterprise data base for survey purposes.

Since regionalization is occurring concurrently with the development of DCPDS, it was necessary to develop software to streamline certain personnel functions for the regionalized environment as a stopgap measure. These personnel process improvement functions include:

- Training assignments.
- Job position development.
- Major personnel actions.
- Ad hoc data base search and query.

DCPDS supports the ***information superiority*** envisioned in ***Joint Vision 2020*** by providing a seamless integration of civilian personnel information within the Defense Department.

BACKGROUND INFORMATION

The four personnel process improvement functions, which are also known as the interim DCPDS system, underwent an OA in FY96. The OA indicated that personnel process improvements were not being employed by the personnelists in their day-to-day activities. As a result, little useful data could be collected regarding their performance. It was concluded that the sites had not implemented the personnel process improvements for a variety of reasons including:

- Insufficient training.
- Inadequate business process planning.
- Immature software.

DOT&E recommended that the implementation plans and training program be improved and that another OA be conducted in FY97. Hardware buys to implement the personnel process improvements, except for those necessary to ensure the continuation of the separate personnel center regionalization program, were put on hold until personnel process improvements were shown to be operationally effective and suitable.

An OA on the interim suite of personnel process improvements was conducted in early 1997 at several operating DCPDS sites involving the Services (Air Force, Army, Navy, and Marine Corps) and other non-Service organizations (such as Washington Headquarters Service). This OA focused on the interim system's ability to support civilian personnel operations in a regionalized environment. The OA also evaluated progress in the developmental effort to produce the objective modernized DCPDS.

The results indicate that personnel process improvements were being used profitably by most of the sites surveyed. In general, the personnelists found them superior to the legacy systems because they made their jobs easier to perform by automating tasks once done manually. However, the OA also found that effective use of the personnel process improvements depended to a larger degree on the development of a strong infrastructure, including the level of resources and time devoted to implementing the revised business practices that the interim system requires for improved productivity. The interim system generally performed better at the sites that put more resources towards implementing the interim system.

The 1997 OA also showed that there is a moderate risk that the objective DCPDS will not be delivered on time or ready for OT&E. Deficiencies were found in the areas of programmatic documentation, traceability of operational requirements through system design documentation in the production software, and degree of software development completion.

During FY98 and early FY99, T&E activities were limited to developmental and technical testing. This activity included software unit testing and integration testing in which the system's end-to-end performance was tested in a laboratory environment. The formal Software Qualification Test (SQT), the last DT prior to OT, was initiated. Representatives from the components participated in the integration testing and the SQT.

TEST & EVALUATION ACTIVITY

During the period extending from June 1999-February 2000, AFOTEC conducted OT&E on DCPDS at several test sites in two stages—system level evaluation and dedicated OT&E—in accordance with the DOT&E-approved TEMP and OTP. AFOTEC employed a new test approach, Combined Test Force, to maximize the sharing of data collected at all phases of testing.

The first phase of OT&E, system level evaluation, consisted of verifying system performance requirements articulated in the ORD. Data was collected during a SQT, which is usually considered a DT event, from June-July 1999, by users from all Services executing test scripts in a laboratory setting. The SQT was designed and managed by the DCPDS Combined Test Force. Additional testing was carried out during a follow-on Operational Field Test (OFT), a combined DT/OT event executed under limited field conditions with Army users at Ft. Richardson, AK, in December 1999. The OFT was designed and managed by AFOTEC.

The second phase of OT&E, the dedicated OT&E phase, was conducted at civilian personnel offices supporting three Service components at Ft Richardson, AK; Ft. Shafter, HI; Silverdale, WA; McChord AFB, WA; and Randolph AFB, TX. The dedicated OT&E was conducted from January 10-February 16, 2000. This test phase was directed exclusively by AFOTEC, which used mission task accomplishment analyses to evaluate DCPDS operational effectiveness and suitability.

TEST & EVALUATION ASSESSMENT

Several shortcomings in the execution of DCPDS OT&E were noted by DOT&E. Prominent among these were inadequate data collection during the dedicated OT phase and frequent system baseline changes during the test events. However, the most significant shortfall was that operational requirements were significantly reduced just prior to the start of the dedicated OT phase. Accordingly, no testing was carried out to evaluate the performance of several major system capabilities. As a result of these and other shortcomings, DOT&E directed that additional testing be completed prior to full fielding. This follow-on testing is currently scheduled for early 2001.

E-3 AIRBORNE WARNING AND CONTROL SYSTEM (AWACS)

Radar System Improvement Program

Air Force ACAT IC Program		**Prime Contractor**
Total Number of Systems:	33 airborne 3 ground test	Boeing Northrop Grumman
Total Program Cost (TY$):	$895M	
Average Unit Cost (TY$):	$14.7M	
Full-rate production:	4QFY97	

Block 40/45 Upgrade

Air Force ACAT ID Program		**Prime Contractor**
Total Number of Systems:	33 airborne	Boeing
Total Program Cost (TY$):	TBD	
Average Unit Cost (TY$):	TBD	
Full-rate production:	FY07	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The E-3 Airborne Warning and Control System (AWACS) provides battle commanders with the ability to observe, assess, and control the entire air battlespace, enabling ***precision engagement*** through ***information superiority*** to the ***dominant maneuver*** force as they engage the enemy. AWACS has been employed in support of joint and multinational operations around the world.

E-3 AWACS is a commercial Boeing 707-320C airframe, modified with an AN/APY-1 or AN/APY-2 radar. It is equipped with general and specialized mission computers, multi-purpose displays, and clear and secure multiple-voice and data link communications. The United States has a total of 33 E-3s, assigned to Pacific Air Forces and Air Combat Command. NATO, Great Britain, France, and Saudi Arabia also operate variants of the E-3.

The Radar System Improvement Program (RSIP) is a joint U.S., U.K., and NATO radar hardware and software upgrade for the E-3 Sentry AWACS. RSIP is designed to improve the E-3 radar detection capabilities in both benign and jamming environments, as well as enhance radar system reliability.

The Air Force is currently studying which upgrades to include in the next major AWACS modification, Block 40/45. This upgrade will center on replacing the current mission computer and the operators terminals with a COTS computer and a network of operator workstations. It will also enable the Air Force to incorporate several necessary improvements to AWACS functionality, including: (1) multi-source integration; (2) increased Electronic Support Measures system memory; and (3) integration of the Intelligence Broadcast System. These improvements will also be supported by new tracking algorithms, software control of the communications sub-system, human-machine interfaces, and improved data link latency. This upgrade supports continued improvements to E-3 detection and information correlation functions, which extend AWACS capabilities through the 2025-2035 timeframe.

BACKGROUND INFORMATION

Since initial fielding, the U.S. E-3 AWACS has undergone nearly continuous modification. Early modifications included adding a maritime ship radar detection capability, integrating first generation Class 1 Joint Tactical Information Distribution System data link terminals, and increasing operator displays from 9 to 14 to support considerably broadened mission tasks and workloads. A significant number of modifications update mission systems, sub-systems, flight controls, and navigation software, and replace selective hardware components with more reliable parts. The most recent modification, prior to RSIP, was the Block 30/35 upgrade, which included significant improvements in navigation, communication, central mission computer, and electronic countermeasures capabilities.

RSIP replaced the aging AWACS radar sub-system computer, the Airborne Radar Technician workstation, other selected radar system hardware, and radar sub-system software, to improve pulse-Doppler radar sensitivity and resistance to electronic countermeasures. RSIP also increased reliability and maintainability of the modified components. RSIP modification to increase the E-3's radar sensitivity is also planned.

Block 40/45 will replace the aging AWACS computer system, the CC-2E, which is based on an IBM 360 mainframe and the operator's terminals with a network of UNIX-based COTS workstations for the operators linked to several UNIX-based COTS computers, which will perform functions currently resident in the CC-2E, including controlling sensors and processing sensor data and sending/receiving data to data link terminals. The foundation for the Block 40/45 upgrade will be the NATO Mid-Term Upgrade. Block 40/45 should improve the reliability and availability of the E-3, since it will replace obsolete computer hardware for which spare parts are in limited supply. Improved E-3 reliability and availability are increasingly important as theater commanders continue to rely heavily on the E-3's surveillance and control capabilities to provide the information superiority required to control the battlespace.

The Block 40/45 development and test will employ the spiral approach with a number of OT oversight and dedicated OT events to evaluate maturity and reduce risk for IOT&E.

TEST & EVALUATION ACTIVITY

The U.S. RSIP IOT&E started with its first sortie on August 3, 1995. The scheduled six-sortie IOT&E was suspended twice and completed in October 1996. RSIP met operational performance requirements at that time; however, suitability issues remained. Data from U.S. IOT&E were augmented by system performance data gathered during NATO and U.K. tests/exercises, as well as a series of combined developmental/operational test flights.

After the conclusion of IOT&E, the Air Force developed a post-IOT&E action plan to correct the suitability deficiencies highlighted by IOT&E. The plan primarily consisted of software improvements, but also included some hardware improvements. DOT&E monitored the testing of those improvements and analyzed the data. Post-IOT&E results verified significant improvements in RSIP suitability.

The first FOT&E sortie took place on April 8, 1998, using a pre-RSIP AN/APY-1 equipped E-3. This provided a performance baseline of the pre-RSIP AN/APY-1 radar. The RSIP upgrade was installed on that same E-3 in summer 1998, the first operational USAF E-3 to be RSIP-equipped. The first acceptance flight occurred in October 1998. The second FOT&E sortie was conducted on April 16, 1999, as part of the Green Flag 99-3 exercise. The third and final dedicated sortie, the counterpart to the pre-RSIP first sortie, was flown on May 20, 1999. FOT&E collected 500.2 hours of suitability data from the 552nd Air Control Wing's normal use of the aircraft. FOT&E data collection was completed April 14, 2000.

The USAF is currently scoping the Block 40/45 development effort, including starting to prepare a TEMP. During RSIP, combining developmental and operational tests, as well as gathering test data from NATO and U.K. tests/exercises, significantly reduced test costs and duration. Future testing of Block 40/45 will use this same approach, leveraging existing activities wherever practical. Additionally, modeling and simulation will be employed to evaluate maturity and maximum capacity of some of the Block 40/45 components.

TEST & EVALUATION ASSESSMENT

DOT&E analyzed data from both U.S. and NATO IOT&Es and from combined DT/OT, including post-IOT&E testing. DOT&E determined that RSIP is capable of tracking smaller radar cross-section targets at longer ranges than the predecessor AWACS radar. RSIP is also far more effective when operating against electronic countermeasures. Additionally, we found that the RSIP-modified radar provided significant improvements in several areas of suitability. In-flight repair time, diagnostic effectiveness, fault detection, fault isolation, and built-in-test "cannot duplicate" rates were all system successes and there have been no critical failures of RSIP hardware. However, the issue of software maturity plagued RSIP throughout testing prior to Milestone III. DOT&E found the RSIP-modified E-3 to be operationally effective and suitable, with some limitations. The only negative impact to current system capabilities was to the Beyond-the-Horizon (BTH) radar mode. U.S. crews indicated that they experienced degraded ability to use the BTH mode effectively, although NATO crews reported that they actually preferred the change to how the BTH mode worked.

The initial FOT&E sortie flown in April 1998 provided baseline target detection and radar performance data for the AN/APY-1 equipped E-3. This aircraft was subsequently modified with the RSIP upgrade, and the May 20, 1999 dedicated RSIP FOT&E flight collected data to compare against the baseline data. Observations of the second dedicated FOT&E flight, conducted at Green Flag, showed that the aircraft was able to perform its mission as effectively as a pre-RSIP aircraft. No crew or computer workload issues were apparent during this sortie. RSIP hardware and software reliability improved during FOT&E, although software immaturity still has a very high failure rate. Overall, the RSIP radar's reliability is significantly better than that of the pre-RSIP radar. A software change corrected the problem with the BTH mode, providing the same performance as BTH did before the RSIP modification. However, the Air Force has yet to decide whether to implement the change or provide the operator with the option of switching between pre- and post-RSIP settings for BTH.

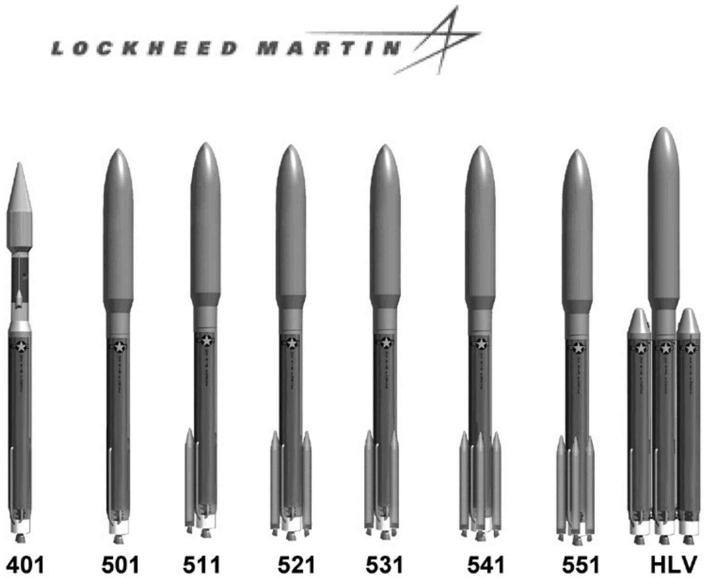
CONCLUSIONS

In the 1997 B-LRIP, the RSIP-modified E-3 was found to be operationally effective and operationally suitable overall, with some limitations. FOT&E re-examined those areas and found that the Air Force had made significant improvements to the system's hardware and software reliability. The only remaining operational suitability limitation is software maturity. The system's software has continued to mature, significantly reducing the rate of critical software failures. Overall, the RSIP-modified E-3 provides significant suitability improvements to the current system.

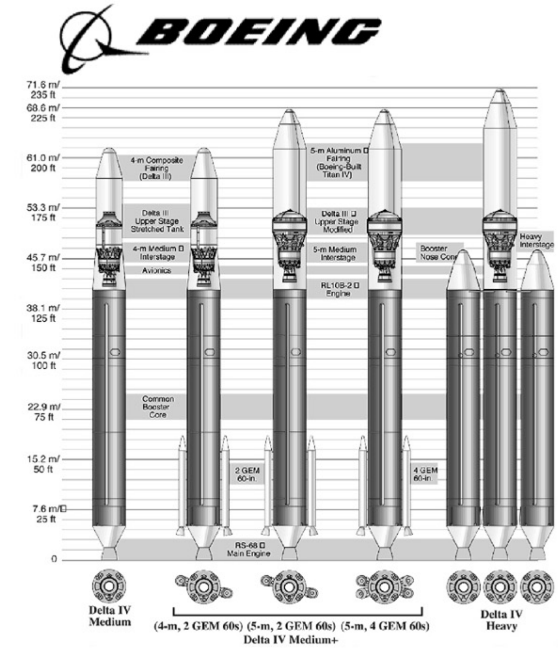
LESSONS LEARNED

Re-hosted radar software led to several problems during the RSIP program, in particular, resulting in inadequate protection of aircraft radar hardware under certain operating conditions and degrading the long-range detection and tracking performance of the BTH radar. Both of these issues have been corrected, and steps have been taken in the ground and air test procedures to prevent recurrences of these problems. However, software maturity remains a concern for RSIP. The Block 40/45 program will require re-hosting significantly more software. The 40/45 program should learn from the RSIP program to prevent a repeat of the problems seen in RSIP. DOT&E will ensure coordination occurs between the E-3 AWACS and E-2C Hawkeye program experts to leverage lessons learned and highlight potential pitfalls during multiple simultaneous upgrades.

EVOLVED EXPENDABLE LAUNCH VEHICLE (EELV)



Atlas V Naming Convention: xyz x = PLF Diameter (meters, approx) y = No. of SRBs (0 to 5) z = No. of Centaur Engines (1 or 2)		
Series	400	500
PLF	EPF (Std) LPF (Opt)	5-m Short (Std) 5-m Med (Opt)
SRBs	0	0 to 5
Centaur Engines	1 or 2	1 or 2



Air Force ACAT ID Program

Total Number of Systems:	181 launch services
Total Program Cost (TY$):	$17.3B
Average Unit Cost (TY$)	$95.2M
Milestone III:	FY03

Prime Contractors

Boeing and Lockheed Martin

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The mission of the Evolved Expendable Launch Vehicle (EELV) is to develop a national launch capability that satisfies the Government's launch requirements and reduces the cost of space launch by at least 25 percent compared with existing systems (with a goal to reduce costs by 50 percent). The EELV launch forecast for the FY02-FY20 period includes 117 Air Force and 64 National Reconnaissance Office missions for a total of 181 launches. Both contractors' families of EELV configurations will support the full range of payload requirements specified in the Operational Requirements Document. The current competing concepts are evolutionary outgrowths of the Boeing Delta II & III and Lockheed Martin Atlas II & III launch vehicles. Boeing's EELV family of launch vehicles are designated as Delta IV, and Lockheed Martin's family of launch vehicles are designated as Atlas V. The current acquisition strategy is to retain both contractor versions of EELV throughout the life of the program.

EELV must be capable of launching payloads weighing between 2,500 and 41,000 pounds to seven different orbits with apogees ranging from 100 to 21,150 nautical miles above the Earth. The

EELV system includes launch vehicles, infrastructure, support systems, and interfaces. Payload interfaces will be standardized so that any payload can be mated with either contractor's launch vehicle. Launch pads and infrastructure will be standardized in that all configurations of each contractor's EELV family can be launched from the same pad. EELV will support military, intelligence, and civil mission requirements in the National Launch Forecast currently serviced by Titan II, Delta II, Atlas II, and Titan IV.

As an evolutionary space launch system, EELV is based on ***innovation*** to secure our nation's assured access to space. This launch capability will enable the U.S. to take the high ground of space and help achieve the military concept of ***full-dimensional protection***.

BACKGROUND INFORMATION

The EELV Acquisition Strategy has evolved since 1995 when the Government planned to downselect to a single contractor for launch services. Under the second revision to that strategy (approved in November 1997), the Government will procure launch services from two contractors, Boeing and Lockheed Martin. The Air Force judged that the growing commercial spacelift market would support increased cost sharing by two U.S. contractors and provide the nation with a more robust access to space. An initial launch services contract, for 28 launches from FY02-FY06, was awarded in October 1998, with the contractors' shares determined by competitive source selection.

The Under Secretary of Defense for Acquisition, Technology and Logistics (USD(A,T&L)) approved a third revision to the original EELV acquisition strategy in September 2000. The revised strategy captures: (1) recommended actions resulting from the DoD Launch Broad Area Review ("Launch BAR") mandated by the President; (2) approval by the Deputy Secretary of Defense, the Secretary of the Air Force, and the USD(A,T&L) of Lockheed Martin Corporation's request to delete their West Coast EELV launch service capability requirement; and (3) recommended actions resulting from the Secretary of the Air Force-directed EELV Joint Assessment Team ("EELV JAT"). As a result, Boeing will be the sole-source provider of West Coast EELV launch services through 2010. Lockheed Martin will still complete design and flight qualify the associated hardware for a Heavy Lift Vehicle of the Atlas V family of vehicles, which could be launched from their East Coast launch pad. One of the Launch BAR and EELV JAT recommendations incorporated into the revised acquisition strategy is to conduct a Heavy Lift Vehicle (HLV) Operational Launch Services Demonstration in FY03 prior to the first government mission HLV launch.

The EELV TEMP describes a test strategy that relies almost exclusively on combined developmental/operational testing. The operational testing community has been participating continuously with the Program Office and with each of the contractors to monitor ongoing test activities. The test strategy includes extensive use of models and simulations to predict individual sub-system and total system performance. The test strategy includes two OAs and a dedicated IOT&E phase for each contractor. The first OA, which AFOTEC conducted from FY97-FY98, supported the Milestone II decision in September 1998. The second OA, which began in FY99 and extends to FY02, will provide an assessment to support the Air Force Space Command launch readiness decision for the government's first medium-lift vehicle flight planned for FY02. The first heavy-lift vehicle flight is a government mission planned for FY03 and will be included as part of the system IOT&E. Each EELV rocket will carry an operational payload, with the exception of the heavy lift vehicle demonstration (Delta IV).

As described in the current TEMP, dedicated IOT&E will begin with the first government launch and is currently scheduled for the FY02-FY03 period. Eight operational EELV flights are projected during the IOT&E timeframe. Several commercial flights are planned prior to and during the government IOT&E period; additional data will be collected during these commercial flights to augment government launch test data.

TEST & EVALUATION ACTIVITY

The pace of developmental and qualification testing increased during FY00. The operational test community participated in numerous design reviews and observed as much of the test activity as possible given limited staffing.

- Boeing Delta IV Development Testing: Significant concerns arose during developmental testing of the RS-68 main engine, which required several fuel turbopump design changes. The RS-68 development issues caused Boeing to re-baseline their first commercial launch from April 2001 to November 2001. Qualification tests for the major structural components of the Common Booster Core and Upper Stage and the avionics began in FY00 and are well underway. The successful Delta III flight of August 23, 2000 reduced the risk associated with Delta IV since Delta IV will use the Delta III RL-10B-2 upper stage engine and the two vehicles also share some avionics components.

- Lockheed Martin Space Systems Atlas V Development Testing: All areas of the Atlas V have components in qualification testing, including the avionics system and both the liquid oxygen and propellant tanks. On May 24, 2000, Lockheed Martin successfully launched the first Atlas IIIA commercial vehicle powered by a Russian-built RD-180 main engine and with a single-engine Centaur Upper Stage engine. The Atlas IIIA/B are viewed as evolutionary steps for the EELV Atlas V family since the two rocket lines have about 80 percent commonality of parts, engines (i.e., the RD-180 and Centaur), and avionics. This successful flight reduced the overall design risk for the Atlas V.

AFOTEC established a liaison office at Los Angeles Air Force Base to facilitate more complete and timely exchange of information between the EELV program and the test community.

TEST & EVALUATION ASSESSMENT

DOT&E considers the currently approved T&E strategy to be adequate, but cautions that it is the minimum level of effort required to adequately evaluate the EELV system. Adding the Boeing Delta IV Heavy Lift Vehicle (HLV) Operational Launch Services Demonstration before the first government HLV flight strongly benefits the test program and mitigates risk.

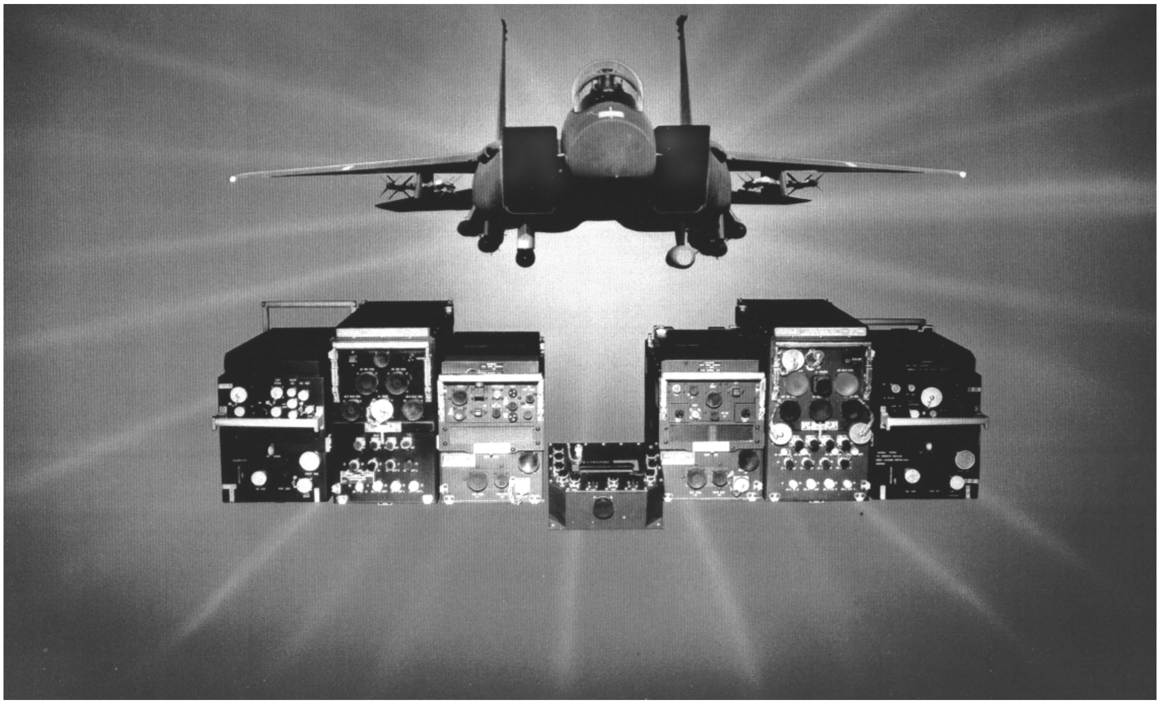
AFOTEC's second OA, which is currently in progress, is assessing space launch operations, EELV operational effectiveness and suitability, and operational factors that impact spacelift support to the warfighter. The primary space launch operations issues are: (1) the capability to deploy, sustain, and augment space-based capabilities supporting various government users; and (2) the deploy-on-demand responsiveness of the EELV system in support of contingencies and major theater war. The EELV effectiveness and suitability assessment focuses more directly on the performance of the launch vehicle itself. Space launch supporting functions being examined include launch vehicle preparation, payload preparation, launch control operations, logistics, surge launch rate, the ability to interchange payloads, range preparation, and range post-launch recovery.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

The 1998 TEMP must be updated to reflect recent progress and planned changes to each contractor's program, as well as reflect AFOTEC's planned improvements to the overall operational test strategy. DOT&E considers AFOTEC participation to be essential to this program.

The Program Manager has re-invigorated his EELV "homeweek" meetings, which are three day, government-only, immersion sessions to review every aspect of the Boeing and Lockheed Martin development programs and mission integration activities. However, despite these attempts to facilitate communications flow, there are still continuing problems with operational test community access to contractor information. Currently, access must be coordinated through the System Program Office, which is often a slow and tedious process. This process effectively limited timely access to contractor technical information during the first OA. Open and timely access to information has improved but is still a limiting factor.

F-15 TACTICAL ELECTRONIC WARFARE SYSTEM (TEWS) (AN/ALQ-135 BAND 1.5)



Air Force ACAT III Program

Total Number of Systems:	162	
Total Program Cost (TY$):	$368.7M	
Average Unit Cost (TY$):	$2.057M	

Prime Contractor
Northrop Grumman

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The F-15 Tactical Electronic Warfare System (TEWS) AN/ALQ-135 Band 1.5 contributes to ***full-dimensional protection*** by improving individual aircraft probability of survival through improved air crew situation awareness of the radar guided threat environment, cueing both active and passive countermeasures in the Band 1.5 frequency spectrum, and adding a waveform select feature for jamming optimization against specific threats. The F-15 TEWS consists of the AN/ALR-56C radar warning receiver, the AN/ALQ-135 internal countermeasures set, the AN/ALQ-128 electronic warfare warning set, and the AN/ALE-40/45 countermeasures dispenser. TEWS provides electronic detection and identification of surface and airborne threats. In addition, it allows for activation of appropriate countermeasures, including electronic jamming and dispensing of expendables such as chaff and flares.

Integral to F-15 TEWS, ALQ-135 is an internally mounted responsive radio frequency jammer designed to counter surface-to-air and air-to-air threats with minimum aircrew activity. The system has an improved reprogramming support capability that rapidly changes pre-flight message software in response to changing threat parameters and mission requirements. ALQ-135 has been fielded in several phases to provide incremental improvements to jamming coverage. The Band 3 version of the ALQ-135 operates against threats at higher frequencies and has been fielded with the F-15E for over 10 years. It allows full interoperability and robust jamming techniques against modern Pulse-Doppler radar threat systems. Currently, there is no ALQ-135 capability against threats operating at lower frequencies. For this reason, the U.S. Air Force has placed high priority on the Band 1.5 program to fill this void. Band 1.5 is completely dependent on Band 3 for signal reception, processing, and interfacing with the rest of aircraft avionics. Future plans call for the integration of a Fiber Optic Towed Decoy (FOTD) to the existing TEWS system. FOTD is based on Integrated Defensive Electronic Countermeasures technology and is currently scheduled for TEWS integration in 2005.

Operational maintenance of TEWS is supported by the incorporation of a Built-In-Test (BIT) system to allow detection and isolation of system malfunctions by maintainers. BIT also functions to ascertain system health and status for the aircrew prior to entering a threat area; it is designed to contribute to ***focused logistics*** aspects of ***Joint Vision 2020*** by implementing a means for aircrew and maintainers to assess confidence in TEWS performance prior to and during a mission.

BACKGROUND INFORMATION

ALQ-135 is an outgrowth of an early 1980s feasibility demonstration and a follow-on quick reaction capability high band jammer developed to counter rapidly changing threats. Since then, there has been a continuing need for the F-15E aircraft to possess a radio frequency countermeasures system to survive engagements with hostile surface-to-air and air-to-air weapon systems. The jamming system must be integrated with other F-15E avionics and be interoperable within multi-ship F-15E flights. A multi-faceted development and test program was established within the constraints of funding and technology. Since most high priority threats are in the higher frequency bands, early priority was placed on the ALQ-135 Band 3 sub-system. Band 3 was initially deployed with the 4th Fighter Wing F-15Es during Operations Desert Shield/Storm.

DOT&E has exercised test oversight only on the TEWS version installed in the F-15E Strike Eagle. Testing conducted under DOT&E oversight was as follows:

- In November 1990, Air Combat Command (ACC) completed an Early Operational Assessment of the F-15E TEWS and identified system problems fundamentally due to the early stage of software development.
- Four years later, in 1994, AFOTEC conducted an Operational Assessment of the F-15E leading to the conclusion that the system would be unlikely to pass IOT&E.
- In 1998, the Band 1.5 DT phase began, but was encumbered by software immaturity and integration problems with Band 3.0.
- IOT&E began in May 1999, and was completed in July 1999. During this period, 38 open-air range test sorties were conducted, accumulating over 84 flight hours (103 operating hours) with numerous re-sets, BIT false alarms, and unexplained in-flight faults. Seven deficiency reports were written by AFOTEC.

In October 1999, as a result of those deficiency reports, the AFOTEC commander de-certified the system from IOT&E, leading to the year 2000 Combined DT/OT and IOT&E (referred to herein as 2000 IOT&E). This effort consisted of Installed System Test Facility (ISTF) operations in the PRIMES anechoic chamber at Eglin AFB, and a series of 55 open-air range sorties at the Eglin AFB Multi-Spectral Test and Training Environment and the Nellis AFB Test and Training Range.

TEST & EVALUATION ACTIVITY

In-plant testing of the new Operational Flight Program (OFP) (version NPT629) was conducted during the period November 1999-February 2000. Based on this testing (including a re-evaluation of BIT performance) at the Northrup Grumman facility in Rolling Meadows, IL, the ALQ-135 was re-certified to enter its year 2000 IOT&E.

The 2000 IOT&E consisted of ISTF operations in the PRIMES anechoic chamber and a series of 55 open-air range sorties at Eglin AFB and Nellis AFB. A total of 109 flight hours (137 operating hours) were accumulated during this IOT&E. Fifteen of the 55 sorties were dedicated to evaluation of the system's contribution to reducing the lethality of SAM systems. Additional test sorties were added as opportunities arose to evaluate effectiveness against air-to-air missile systems. Twenty-eight sorties were run to assess suitability improvements. Three operational aircraft from Nellis AFB, as well as one Eglin AFB instrumented aircraft, participated in this test sub-phase. Twelve sorties were flown at Nellis AFB under operationally realistic conditions involving air-to-ground ordnance release and the use of chaff and maneuvers to accompany active ALQ-135 jamming.

TEST & EVALUATION ASSESSMENT

DOT&E concludes that the system is operationally effective but not suitable (see the B-LRIP report to Congress dated December 2000 for more detail).

Results of the 2000 IOT&E indicate that the ALQ-135 is effective as measured by the system's capability to reduce the lethality of those SAM systems required by Air Combat Command. However, the ALQ-135 threshold criteria for effectiveness was focused only on Band 1.5 and does not address the newer SAM systems.

Effectiveness of the entire TEWS against air-to-air systems and capability to engage multiple high duty cycle type threats remains to be evaluated. The addition of Band 1.5 equipment to the existing TEWS adds value to the self-protection capability of the F-15E and completes the TEWS suite as originally designed.

Reliability, Maintainability, and Operational Availability do not meet System Operational Requirements Document specified thresholds and objectives.

Suitability of the ALQ-135 depends on the capability of the Built-In-Test (BIT) to identify faults, along with the capability to take corrective action in a timely manner. The OFP changes made to improve BIT were ineffective; BIT false alarm rate is 65 percent. The BIT system for the ALQ-135 is the only means available for the aircrew to establish readiness (health) of the system prior to entering a threat area. An excessive false alarm rate (e.g., ≥ 20 percent) causes not only an unwarranted number of maintenance actions, but also operates to distract aircrew attention from primary mission functions.

The TEWS system BIT/Integrated Diagnostics capability is totally inadequate and, in operational practice, is ignored because of its unreliability. Based on the data analyzed during IOT&E, it is apparent that F-15E aircrews have a tactical jammer that is: (1) unreliable; (2) unable to diagnose true systems status/operational capability; and (3) does not provide aircrew adequate cues or confidence of its actual operating status. The lack of a quality, trusted integrated diagnostics and BIT system is unsatisfactory.

Operational Availability (Ao) is a measure of the system's readiness for use when needed (uptime) as compared to total "ownership" time (uptime plus downtime). Ao was 80 percent based on Follow-On DT/OT data compared to the 63 percent estimate achieved during 1999 IOT&E. The Air Combat Command objective for Ao is greater than 96 percent.

An additional shortfall with the TEWS system is a longstanding problem with the ALR-56C Radar Warning Receiver. In a dense signal environment, ALR-56C lacks adequate processing capability, as evidenced by incomplete and/or slow display of threat emitters to aircrews. The lack of timely threat cueing and processor throughput is recognized by the Air Force, but correction of this deficiency awaits higher priority in the F-15E funding program.

RECOMMENDATIONS

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Because the Band 1.5 equipment adds an important capability to the F-15E for operations defended by a widely deployed though older SAM system, Band 1.5 production should continue. However, neither development nor reliability testing of the F-15E TEWS has been adequate. Additional development work on BIT design, and a reliability improvement program and FOT&E on the ALQ-135 is needed. A dedicated IOT&E for the TEWS/Fiber Optic Towed Decoy (FOTD) appliqué, currently scheduled for deployment around 2005, will be required.

Corrective action and further operational testing are required in three areas in order to reduce: latent hardware reliability problems, latent software reliability problems, and BIT performance. In addition, experience with installation of Band 1.5 ship sets into operational aircraft for the 2000 IOT&E indicates that systemic problems will exist as Band 1.5 is installed.

Latent hardware deficiencies should be corrected and tested in order to reduce those that show up intermittently (such as when the system is airborne and not on the ground)—a possible reason for the large number of false alarms. Environmental chamber testing, such as that performed for standard qualification and reliability growth testing, should be conducted at the ALQ-135 system level.

Latent software deficiencies manifested by a high re-set rate (0.46 per hour; 1.2 per sortie) need to be addressed in order to avoid future problems with the FOTD appliqué. This will require that adequate regression and stress testing become institutionalized, in addition to careful monitoring of software performance during the qualification/reliability growth tests recommended above.

Additional development work on BIT design, and a software/hardware reliability improvement program are needed. The F-15E Band 3 system has been in operational use for over 10 years. ACC seems to have accepted its RAM deficiencies, and has placed first priority on completing the ALQ-135 by installing Band 1.5 equipment. However, until the known system deficiencies (jammer outages under threat exposure conditions and inability to maintain consistent BIT performance), the Band 1.5 addition should not be considered fully effective and suitable.

The most immediate area of corrective action is the need to reduce the false alarm rate of the BIT sub-system. This problem erodes confidence in the BIT but more importantly operates to reduce the reliability of the system by inability to distinguish real failures from false alarms. With a non-reliable

BIT, many real failures tend to remain undiscovered as maintainers attribute them to BIT misdiagnoses rather than to specific ALQ-135 components.

A system reliability improvement program and a BIT fundamental design review with updated documentation should be instituted. Such efforts would be advisable as the FOTD is integrated into TEWS. Also, because of the production effects exhibited during year 2000 IOT&E, additional oversight of the contractor's in-plant quality system is needed.

F-22 RAPTOR (ATF)

Air Force ACAT ID Program

Total Number of Systems:	339
Total Program Cost (TY$):	$63.4B
Average Flyaway Cost (TY$):	$83.6M
Full-rate production:	4QFY03

Prime Contractor

Lockheed Martin, Boeing, Pratt &Whitney

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The F-22 is an air superiority fighter designed to dominate the air environment in the 21st century. Key features include low radar observability (with internal weapons carriage) and supersonic cruise combined with the classic fighter characteristics of superior maneuverability, wide field-of-regard offensive and defensive sensors, multi-spectral countermeasures, and high reliability.

Basic armament of the F-22 consists of six AIM-120C missiles, two AIM-9 missiles, and a 20mm cannon. F-22 will be a major contributor to the ***Joint Vision 2020*** future strategy. It is to be a predominant Air Force weapon system to provide ***full-dimensional protection*** to all forces, and its stealth, integrated offensive and defensive sensors, and air-to-air and air-to-ground weapons mix are to effectively support ***precision engagement*** and ***dominant maneuver***.

BACKGROUND INFORMATION

F-22 completed the Milestone II DAB and entered the EMD phase in July 1991. Since then, the program has undergone several major changes due to schedule delays, budget reductions, and cost growth. An independent Joint Estimating Team identified significant cost growth in the EMD phase and recommended restructuring EMD. This program restructure was approved by a February 5, 1997, DAB. A primary element of this restructure was elimination of the four Pre-Production Vehicles. The essential IOT&E impact of this change was the assignment of four aircraft (4008-4011) and one spare aircraft (4007) during four ship operations. Aircraft 4010 and Aircraft 4011 are Production Representative Test Vehicles (PRTV 1) and are the performance baseline for OT test aircraft. This program restructure also increased the length of the EMD phase by nine months, allowing more time for integrated avionics testing. Dedicated IOT&E is currently scheduled to begin in August 2002, with Milestone III scheduled for September 2003.

In December 1999, the DAB delayed the planned LRIP decision and designated the next block of six aircraft as Production Representative Test Vehicles II (PRTV II). It also provided long lead-time funding for the LRIP Lot 1 of 10 aircraft and established exit criteria for the LRIP decision planned for December 2000. The test-related exit criteria are listed below:

- Complete avionics Block 3.0 first flight, initiating testing of Block 3.0 unique functionality.
- Complete first flight on EMD Aircraft 4003, 4004, 4005, and 4006.
- Complete static structural testing.
- Initiate fatigue life testing with the goal of completing 40 percent of first fatigue life.
- Conduct flight testing to include initiating Radar Cross Section (RCS) flight testing, initiating high angle-of-attack testing with weapons bay doors open, and initiating separation testing of AIM-9 and AIM-120 missiles.
- Complete first portion of engine Initial Service Release (ISR) qualification test.

The F-22 was placed under OSD oversight for LFT&E in October 1989 as the Advanced Tactical Fighter. An Alternative Plan for meeting LFT&E objectives was approved, and a waiver from full-up, system-level testing was granted with notification to Congress in August 1997. The alternate Live Fire Test (LFT) plan includes testing to determine hydrodynamic ram structural damage, dry bay fire, and critical component separation as well as demonstration of active fire suppression systems. LFT in prior years has included hydrodynamic ram vulnerability testing of wing box and aft fuel tanks, fire vulnerability testing of wing attach, aft side of fuselage, main landing gear (MLG), airframe mounted accessory drive (AMAD) dry bays, and penetration vulnerability testing of avionics bays. In addition, high explosive threat effect tests were performed to evaluate component separation adequacy. Fuselage fuel tank hydrodynamic ram damage ballistic testing is scheduled for FY01. A realistic forward fuselage test article has been manufactured for this test. Aircraft 4001 is scheduled to be used for wing fuel tank hydrodynamic ram damage and leading edge dry bay fire ballistic tests in FY01 and FY02.

TEST & EVALUATION ACTIVITY

The first flight of the EMD flight test program, Aircraft 4001, occurred on September 7, 1997, at Lockheed Martin, Marietta, GA. After being transported from Marietta, the first test aircraft resumed test flights at Edwards AFB on May 17, 1998. Aircraft 4002 first flight was on June 29, 1998, and its ferry to Edwards AFB occurred on August 26, 1998. Both aircraft expanded the allowable flight envelope and have accumulated 797.4 hours at of the end of calendar year 2000. Aircraft 4003 first flight occurred on March 6, 2000, and ferried to Edwards AFB on March 15, 2000. Following an extended modification and calibration period at Edwards AFB, this aircraft started productive flight testing on September 19, 2000, and accumulated 31.9 hours by the end of calendar year 2000.

DOT&E's activities this year continued to support test planning outlined in the August 1997 F-22 TEMP. Toward this end, DOT&E participated in Integrated Product Team (IPT) meetings of the Test Planning Working Group (TPWG), Air Combat Simulator (ACS) management reviews, IOT&E Red Force Working Group, and Working IPT (WIPT) meetings. Additional program insight was provided by visits to contractor facilities in Marietta, GA, and Seattle, WA. The Seattle visits included two Flying Test Bed (FTB) test flights. A TEMP revision is required to support the LRIP DAB. Four TEMP working group sessions were held to address 11 issues submitted by DOT&E during the West Palm Beach TPWG in January 2000. All issues have been resolved and the TEMP has been approved.

Development of the ACS, consisting of two domes and ten manned interactive cockpit stations at Marietta, GA, continued in the system development stage. A $5.7 million budget reduction in March 1998 forced substitution of a Commercial-Off-The-Shelf computer to host F-22 mission software instead of the original plan to host the mission software portion of the aircraft's operational flight program on the Common Integrated Processor flight hardware in ACS. Restructuring ACS to accommodate this change has occurred with IOC to support IOT&E scheduled for November 2001. The ACS team moved into the new F-22 Air Vehicle Integration Facility this year and have received delivery of their first simulator dome. DOT&E reviewed ACS development plans periodically during this year to ensure that test adequacy is not being compromised by strong cost reduction pressures.

An FTB, consisting of an APG-77 radar in an F-22 forebody spliced onto the nose of a Boeing 757 test aircraft, completed the radar phase of testing early this year. After it was modified to install a sensor wing (containing some of the F-22 sensors and wing antennas) on top of the fuselage, FTB testing resumed emphasizing multi-sensor fusion of radar; Communication, Navigation, and Identification (CNI); and EW sub-systems. Block 3S software was tested against a variety of air and ground targets as a precursor to the initiation of Block 3.0 software testing on September 1, 2000—almost a month ahead of schedule. This FTB development testing of Block 3.0 software was a key part of the process leading to flying this software in Aircraft 4005. The Director, OT&E and his staff participated in a FTB Block 3.0 development mission this year, and his staff also participated in a Block 3S development mission earlier this year.

An equally important part of the avionics development process is played by the Avionics Integration Lab (AIL) at Boeing's Seattle plant. Development and troubleshooting of all software blocks have been conducted in this test facility since 1998. Block 3.1 software fusion of radar, CNI, and EW is in development testing in the AIL and will soon be installed in the FTB. The Block 3.1 software will provide the core functions of Block 3.1.1 software to be demonstrated in IOT&E. Block 3.1.1 is now starting elemental testing and will transition the AIL testing in mid-2001 and to FTB testing by late 2001.

Static structural testing has been conducted during the past two years, starting in April 1999. Testing was successfully completed to 100 percent of Design Limit Load (DLL) in 1999, and plans were to complete the ultimate load testing (150 percent of design loading) in 2000. The start of static structural testing was significantly delayed due to flaperon repairs. Also, the failure of the static test fixture, housing the test vehicle, at 141 percent of design limit load will further delay static testing to 150 percent of design ultimate load. However, static testing to 141 percent design limit load will support Aircraft 4003 clean envelope expansion, thereby meeting the LRIP DAB exit criterion. Approximately one and one-half months are required to redesign and change the material of the failed fixture component.

Delays in static testing also impacted the initiation of fatigue testing from the original scheduled start in early 2000 to actual start on December 21, 2000. The applicable LRIP DAB exit criterion, established in December 1999, is initiation of fatigue testing with a goal of 40 percent of first life complete by the end of 2000. While the LRIP DAB exit criterion was met, the goal was not since only about one percent of the first life has been accomplished. Although this fatigue testing does not impact expansion of the allowable flight envelope, completion of the first fatigue life does affect the point at which structural changes, necessitated by the results of fatigue testing, can be installed into the production line.

LFT&E activities in 2000 have focused on pre-test analysis and test planning for fuel tank hydrodynamic ram damage tests. Test planning and pre-test evaluation were performed for upcoming tests on a replica of the fuselage fuel tank and Aircraft 4001 wing scheduled for FY01. The Air Force conducted hydrodynamic ram analyses of the fuselage fuel tank to identify appropriate shotlines. A shotline was selected which will provide data to evaluate fuselage fuel tank hydrodynamic ram damage and its affect on safe operation of the crew escape system. A change in threat projectile for this test has required a re-evaluation of the pre-test predictions. Analyses were also conducted in support of LFT&E to assist shotline selection for the upcoming wing hydrodynamic ram test. A shotline was selected and detailed wing hydrodynamic ram damage analyses are being conducted to predict results of the test, which will be performed on Aircraft 4001.

Engine testing remains on schedule to support the flight test program through the end of EMD. The LRIP DAB exit criterion "Complete first portion of engine Initial Service Release (ISR) qualification test (2150 TACs - full hot section life)" was completed on Flight Test Engine (FTE) #18 on November 3, 2000. The complete ISR qualification test of 4325 Tactical Accelerated Cycles (TACs) is expected to be completed before the end of 2001. Based on this nearly-on-schedule test performance, engine deliveries to support the two PRTV I aircraft (Aircraft 4010 and Aircraft 4011) for IOT&E support should not be a problem. The F119 engine performance and reliability in the three F-22 flight test aircraft have been the highlight of the F-22 flight test program. There has not been an engine-caused failure to complete a scheduled test condition. In addition, there has not been an engine-related shutdown to this point in the test program, although there have been two precautionary shutdowns due to indications of Airframe Mounted Accessory Drive (AMAD) and generator problems.

In addition to flight testing at Edwards AFB, logistics testing tasks including initial low observability maintainability tasks are ongoing using low observable test articles and exercising aircraft access doors. The basic F-22 design has some good improvements in terms of minimizing the number of access doors in their design. High reliability is also essential to minimizing access requirements and the attendant low observable restoration procedures. The brush and roll repair process has been developed and should reduce repair risk. The concept for low observable sustainment and how to test it are issues yet to be addressed. Although new materials and techniques have been developed, the plan does not include demonstrating the ability to sustain operations in adverse conditions. In addition, operational field measurement capability has not been fully addressed; plans are to rely solely on maintainer adherence to technical data. Completion of logistics test tasks proceeded throughout this year but were severely constrained by the lack of flight test vehicles with avionics sub-systems.

TEST & EVALUATION ASSESSMENT

The F-22 flight test program has fallen considerably behind schedule during the last year. Although some of the necessary test support activities, such as the Flying Test Bed (FTB) and Avionics Integration Lab (AIL), have been making progress in supporting the test program, the flight testing at Edwards AFB has not met the beginning of the year 2000 projections. As of January 3, 2001, flight test aircraft have only accumulated 324 hours of the 590 hours planned just one year ago. Although Aircraft 4003 was delivered to Edwards AFB on March 15, 2000, it did not begin productive flight testing until September 19, 2000, due to a extended lay-up for structural modifications and instrumentation calibrations. Aircraft 4003 is the first flight test aircraft to incorporate the extensive structural modifications identified as Block II structure, which is the production-representative structural configuration required to expand the permissible flight envelope. This aircraft must, however, complete selective regression testing of the envelope explored by Aircraft 4001 and Aircraft 4002 before it can start to expand beyond these limited flight envelope boundaries. As of January 10, 2001, Aircraft 4003 has only flown for 31.9 hours.

Since January 2000, various problems have caused program delays and occasional flight test stoppages. Test flying was constrained primarily by late delivery of aircraft, canopy transparency cracks, aileron hinge pin problems, flaperon repairs, environmental control system problems, and inlet delamination inspections. As a result of these delays, only about 40 percent of the projected test points have been completed.

Analysis shows that late deliveries of avionics flight test Aircraft 4004 through 4009 requires 8.6 additional months to complete the currently planned 1,970, from the original 2,270, avionics flight test hours. Without any adjustments to the program schedule, the F-22 System Program Office (SPO) estimates that approximately 150 flight hours of planned airframe development testing and about 17 aircraft months of required avionics testing would not be completed by the start of IOT&E. Although some limited airframe and avionics development testing could be accomplished in parallel with IOT&E, there are other required test events that must be completed before start of IOT&E. Also, the scheduling and availability of test assets and resources would limit the scope of any parallel test operations.

The current status of the test program and the SPO schedule estimates show that the planned test program cannot be completed as originally scheduled and that IOT&E cannot be started in August 2002 without clearly unacceptable risks. On December 20, 2000, the Air Force briefed DOT&E with a plan that would defer the start of IOT&E by four to six months allowing additional time to complete the required developmental testing. Although as much as nine months to a year delay may be needed to complete required testing, DOT&E strongly supports the plan.

Weapons internal carriage provides the F-22 with lethal capabilities while maintaining low observability. The integration of avionics and weapons systems to launch precision weapons is a major step in the flight test program for validation of the software block algorithms. These software block algorithms are also necessary for the mission-level simulation in the air combat simulator (ACS) during pilot training and mission-level IOT&E sorties. The completion of three exit criterion, “Initiate high angle-of-attack testing with weapons bay doors open,” “Initiate separation testing of AIM-9 missile,” and “Initiate separation testing of AIM-120 missile” demonstrated the initial test tasks in weapons employment. To date, the flight test program has demonstrated unguided launch of an AIM-9M Sidewinder from the side weapons bay on July 25, 2000, and an unguided launch of an AIM-120 from the main weapon bay on October 14, 2000, from Aircraft 4002. High angle-of-attack testing with the main and side weapons bay doors open began on August 22, 2000. This testing was accomplished relatively easily, further demonstrating the F-22’s outstanding high angle of attack flying qualities.

Flight test validation of the software block necessary for the start of IOT&E pilot upgrade training is critical. The SPO proposed parallel developmental test (DT) sorties during IOT&E should be a DAE review topic to better understand the impact on the EMD schedule. In addition, we are concerned about the deferral of the external weapons/stores flight testing to the Seek Eagle Program, currently planned for FOT&E in 2003 at the earliest. It would be better to do this external carriage testing earlier to identify the aerodynamic impact of external stores, so that any issues could be resolved much sooner.

Completion of static structural testing without any major failures is an important prerequisite for expanding the allowable flight envelope by Aircraft 4003, justifying its selection as an LRIP DAB exit criterion. This has been achieved with only one of 19 major tests left to complete. The initiation of the first fatigue life with a goal of 40 percent of first life is another LRIP DAB exit criterion. Fatigue testing started on December 21, 2000, but only about one percent of the first life has been accomplished. Although this fatigue testing does not directly impact flight envelope expansion, completion of the first fatigue life does affect the point at which structural changes necessitated by fatigue test failures can be inserted in the production line and possible retrofit requirements.

Low observable measurement and maintainability continues to be a risk area, based on previous low observable platforms. This risk category includes reliability and logistics support. The concept for low observable sustainment and how to test it is an issue, not only to validate the new materials and repair techniques, but also to validate the low observable specifications as measured during full-scale pole and chamber testing. All available measurement tools, including ground, air, and range, should be utilized in this validation process. RCS flight testing has not yet begun. The baseline plan showed that this would be conducted in mid-2000 on an outdoor test range after RCS mapping in the Lockheed Martin RCS Measurement Facility in Marietta, GA. However, late aircraft delivery plus RCS impacts from an inflight main landing gear door gap problem and weather delayed open-air range testing. The aircraft went through extensive surface preparations and painting in preparation for this inflight RCS measurement testing. RCS measurement with an alternate inflight air-to-air imaging system was used to spot certain low observability features, but this did not meet the requirement to measure full aircraft RCS at a calibrated range. After Aircraft 4004 is ferried to Edwards AFB, it will complete the final portion of the exit criteria with a flight across a calibrated range.

Early LFT&E of wing hydrodynamic ram effects resulted in a redesign that will be tested using flight test Aircraft 4001. Changes to the wing design included addition of titanium wing spars, an additional wing rib, and additional wing skin fasteners. If successfully demonstrated, the wing redesign will significantly decrease F-22 vulnerability.

The results of the dry bay Live Fire Tests indicate that both MLG and AMAD bays, which lack an onboard fire protection system, pose significant vulnerabilities that could be significantly reduced or even eliminated. Preliminary data show that an effective fire suppression system could be developed using either pentafluoroethane (HFC-125), solid propellant gas generating technologies or other approaches. However, a programmatic decision was made by the Air Force to forgo development of fire extinguishing systems for MLG bay. An onboard fire protection system for the AMAD was not included in the aircraft design. Live Fire Testing has shown that the overall vulnerability had been underestimated. Once the vulnerability models used to estimate the overall vulnerability were updated using the test results, there was a significant increase in F-22 vulnerability. The Air Force relaxed the estimates of F-22 vulnerability requirement by about 30 percent to accommodate increases in the estimated vulnerability since January 1995. The current design meets the new relaxed design specification for vulnerability. Since no significant design changes are expected, additional changes to the vulnerability specification are not anticipated. The overall vulnerability of the current design may change depending on the outcome of the remaining Live Fire Tests.

AFOTEC has initiated a five-year Operational Assessment with periodic briefings and a report, based on a structured strategy-to-task assessment of all F-22 mission tasks, to support the Readiness to Test Certification of IOT&E. AFOTEC identified both positive highlights and potential issues during the interim briefing of operational results this year. The current results were based on bench, lab, and flying test bed data, which supplemented flight test data and extensive participation on the integrated product teams. Performance concerns included risk to avionics integration progress, development of low observable maintenance concept of operations, flight envelope expansion considerations related to structural adequacy analysis, ground handling, cockpit design, security issues, possible operational training constraints, and future performance of the environmental control system. Test and evaluation concerns included consistency of production representation among the operational test aircraft, flight envelope expansion for operational test pilot training, and air-to-air range infrastructure data processing timeline and data display capability for the primary test organization. Since an AFOTEC test pilot and several maintenance personnel are members of the F-22 combined test force, AFOTEC has first-hand knowledge of potential operational problems, thus able to contribute to timely solutions.

LESSONS LEARNED

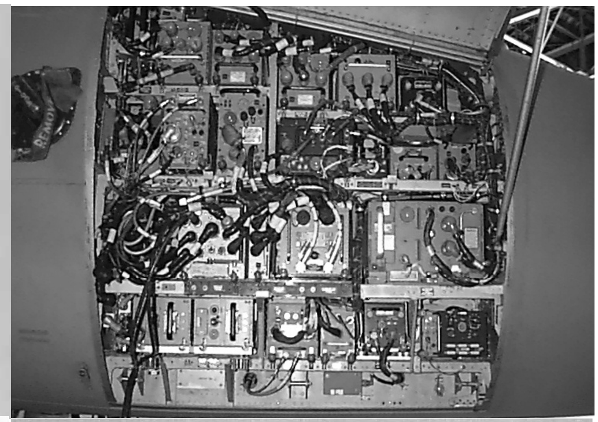
A lesson can be learned from the deletion of the ECS simulator as a cost-saving measure. This decision contributed to the delay of the Aircraft 4004 first flight by at least two months and may indirectly result in further delays to the remaining avionics-equipped test aircraft.

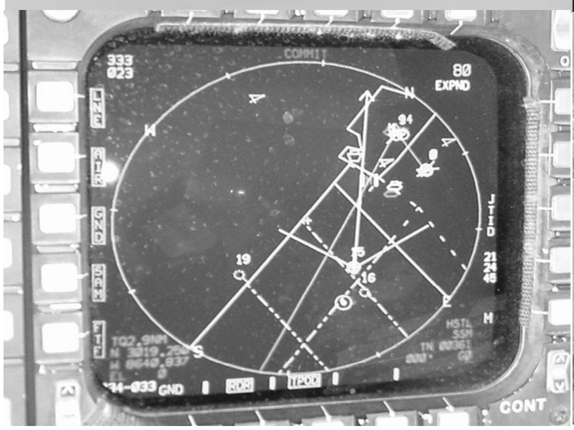
The original LFT&E strategy called for manufacturing a production-representative wing for the hydrodynamic ram test. The Air Force has decided to use flight test Aircraft 4001 for this test as a more economical alternative. Using the flight test vehicle, in addition to economic savings, will provide a more realistic test article. This use of early flight test vehicles to address LFT&E issues should be an option considered in future programs. LFT&E results thus far have shown that dry bay fires do occur but are not predicted well by current modeling and simulation (M&S). Additional M&S effort is required to develop an adequate methodology for predicting dry bay fires, taking into account all independent variables. DOT&E recommends that the Air Force reconsider its decision to eliminate the fire suppression system for the MLG bay as well as consider adding AMAD bay fire protection.

CONCLUSIONS AND RECOMMENDATIONS

As I have stated the last two years in testimony before the Senate Armed Services Committee, AirLand Forces Subcommittee, programmatic efforts to reduce costs to stay within the cost cap almost always result in less testing and increased development risks. These development risks become greater with elapsed time as the cost reduction options become harder to implement. At this point, since the test budget is essentially the only remaining uncommitted EMD budget, cost reductions become test reductions. Any reduction of testing tasks increases the risk of not being ready to start or successfully complete IOT&E.

FIGHTER DATA LINK (FDL)





Joint ACAT ID Program (Navy Lead)	
Total Number of Systems:	685
Total Program Cost (TY$):	$180M
Average Unit Cost (TY$):	$171K
Low-Rate Initial production:	4QFY98
Full-rate production:	1QFY00
F-15A/B/C/D FDL QOT&E:	4QFY99
F-15E FDL QOT&E & MS-OT:	2QFY00
B-LRIP Report Submitted:	1QFY00

Prime Contractor

Boeing – Platform Integration
Data Link Solutions – FDL Terminal

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Multifunctional Information Distribution System Low Volume Terminal 3 (MIDS-LVT 3) Fighter Data Link (FDL), integrated into the active Air Force and Air National Guard (ANG) F-15 fighter aircraft provides **Total Force** situational awareness and sensor cueing in support of the air superiority and air interdiction mission areas. The FDL provides Link 16 data link networking with other Link 16 capable fighter aircraft, command, and control systems to support *synchronized operations*. Link 16 is a Joint and Multinational data link with a common message standard and robust jam-resistant communications waveform providing Joint and Multinational **interoperability** to enable these forces to operate effectively together. As integrated into the F-15 fighter aircraft, FDL provides the fighter aircrew and off-board command and control with a *common relevant operational picture* to apply ***information superiority*** to support ***precision engagement*** and ***dominant maneuver***. F-15 flight leaders use the information and capabilities provided by FDL to avoid threats, locate and identify targets, coordinate engagement by flight members, and disseminate Battle Damage Assessment reports—all in real-time.

The components of FDL include the terminal, remote power supply, F-15 Situation, and Heads Up Displays and controls. The FDL terminal shares a number of Shop Replaceable Unit components with the Multifunctional Information Distribution System-Low Volume Terminal (MIDS-LVT) family of terminals, providing an improved level of ***sustainment interoperability***.

BACKGROUND INFORMATION

The FDL was developed to satisfy an Air Force "Urgent Need" for a Link 16 data link capability for the F-15 fighter aircraft. The terminal was developed independently by the Air Force, but under the umbrella of the MIDS LVT program, and shares approximately 25-30 percent hardware and software commonality with MIDS-LVT. By design, the FDL has less capability than MIDS-LVT: this is a trade-off for lower cost, earlier delivery, and improved terminal reliability while still meeting minimum Air Force and Air National Guard requirements for a Link 16 interoperable data link. The FDL terminal design is modular and shares a common chassis with the MIDS-LVT so that additional capabilities, Tactical Air Navigation, digital voice, and high terminal transmitter output can be inserted into the FDL terminal if required.

The initial host platform for the FDL was the F-15C/D air superiority fighter aircraft. During late FY97, the F-15E air interdiction fighter aircraft was added and the FDL design was modified to create a "common configuration" terminal that could be installed in either fighter aircraft. In FY98, the Air National Guard selected FDL to satisfy their F-15A/B data link requirements.

TEST & EVALUATION ACTIVITY

During FY00, the FDL completed the Combined Electronic Warfare (EW) Developmental Test/Operational (DT/OT) Test, F-15E FDL Developmental Test (DT), Combat Air Forces (CAF) and Joint Interoperability Test Center (JITC) Link 16 interoperability certification tests, F-15E FDL Qualification Operational Test and Evaluation (QOT&E), F-15E FDL Multi-Service Operational Test (MS-OT), FDL Information Assurance (IA) Vulnerability Assessment, and a Maintenance Demonstration. Over 217 FDL flight hours were recorded during FY00 using Common Configuration EMD and LRIP Fighter Data Link terminals.

The F-15 Program Office provided two FDL IA Vulnerability Assessment Reports during May 2000, and AFOTEC released their QOT&E report during May 2000. The developer and AFOTEC provided DOT&E with a DT and OT results briefing on May 23, 2000. The 46th Test Squadron provided a DT Results Report during May 2000.

The F-15E DT (September 1999-March 2000) was conducted primarily at Eglin AFB and the Boeing Corporation St. Louis F-15E bench. The DT evaluated the maturity of FDL integration into the F-15E, as well as corrections to the deficiencies in the FDL F-15A/B/C/D integration discovered during FY99 testing. The DT effort was an open process that included full visibility and frank information exchange with the OTA, developers, and the two contractors.

The combined F-15E DT/OT was conducted from October 6-7, 1999, using the Eglin AFB, FL ranges and adjacent over-water airspace. This test evaluated FDL performance against Big Crow airborne and ground-based jammers, emulating the threat defined in the approved System Threat Assessment Report. Combined DT/OT consisted of two primary profiles: a controlled radial and beam flight pattern by both the F-15E aircraft and Big Crow airborne jammers to measure sensitivity levels at various ranges and aspects, and a realistic scenario involving the approach, location, and simulated air attack of a defended ground target screened by Big Crow jammers.

The CAF F-15E FDL Link 16 certification is an Air Force prerequisite for entry into a Joint Interoperability Test Command (JITC) Link 16 certification. The F-15C/D FDL completed Link 16 certification tests during FY99. The F-15E Link 16 implementation completed CAF certification testing in November-December 1999 and JITC certification testing in March 2000. These certifications are laboratory tests that evaluate message implementation into the host platform, per Military Standard 6016, and the interoperability of the messages with other certification test participants.

AFOTEC conducted F-15E QOT&E from January-March 2000, using the Eglin AFB and Nellis AFB ranges. At Eglin, FDL equipped F-15E fighters flew operationally realistic air interdiction and time critical targeting missions cued by the E-8 Joint Surveillance Targeting Attack System (JSTARS) using Link 16 messages. The Nellis portion employed large numbers of Link 16 capable F-15C and F-15E aircraft in a composite interdiction package controlled by Navy E-2C Hawkeye Airborne Early Warning (AEW) Hawkeye 2000 aircraft.

The MS-OT was conducted in two phases: the first during October 1999 with Link 16 equipped Army Air Defense platforms and the second in conjunction with work-ups for exercise Pacific Blitz. During Pacific Blitz, the FDL F-15Es operated with Navy Link 16 capable platforms. The October 1999 Link 16 network included F-15E fighters, the E-3 Airborne Warning and Control System (AWACS), the Control and Reporting Center (CRC), the Patriot, and the Forward Area Air Defense Command and Control (FAAD C2) platforms. The March 2000 Pacific Blitz work-ups Link 16 network included F-15E fighters, E-2C AEW Hawkeye 2000, and an AEGIS cruiser, USS COWPENS.

In response to a recommendation in the DOT&E Fighter Data Link B-LRIP Report, and consistent with the November 1999 DOT&E policy on IA, the F-15 System Program Office (SPO) funded a FDL IA Vulnerability Assessment. The independently conducted assessment by the Electronic Systems Command Information Warfare Office at Hanscom AFB evaluated FDL manufacturing, test, and operational processes, including Air Force network design and transmission.

The FDL B-LRIP also recommended conduct of a maintenance demonstration to assess FDL Built-In Test (BIT) maturity and adequacy of maintenance publications. The F-15 SPO completed this demonstration with AFOTEC oversight during April 2000. The BIT demonstration was conducted using the F-15E bench at Boeing, (St. Louis) while review of the maintenance publications were conducted at the F-15 Organizational Maintenance Flight at Nellis AFB.

The FOT&E of Fighter Data Link reliability and logistics supportability commenced in April 2000. AFOTEC is conducting FOT&E through data collected from test and operational F-15 FDL equipped units. The first operational F-15C/D squadron at Elemendorf AFB, AK, and the first operational F-15E squadron at RAF Lakenheath, United Kingdom have begun modification to install LRIP FDL terminals. These installations will be complete by the end of the calendar (2000) year, allowing the Air Force to declare Initial Operational Capability for FDL.

TEST & EVALUATION ASSESSMENT

F-15E FDL integration completed OT and was assessed as operationally effective and operationally suitable. FDL met or exceeded all effectiveness COIs, including message success rates during dedicated communications jamming. Compared to JSTARS targeting using voice communications, JSTARS Link 16 targeting provided F-15E aircrew with significantly improved target detection accuracy and strike timeliness. During MS-OT, FDL implementation into the F-15E consistently demonstrated the ability to effectively communicate with Army and Navy Link 16 capable host platforms. Participant location and identification, targets, commands, and engagement coordination messages were exchanged during the execution of realistic combat scenarios in four different types of test range environments.

The MS-OT and QOT&E testing did identify some message implementation deficiencies and information latency issues from the off-board platforms—particularly the E-8 JSTARS, E-3 AWACS, and E-2C AEW. One F-15 display problem with surface ship identity was also discovered. Additionally, AFOTEC indicated that tactics designed to leverage the capabilities of Link 16 information to achieve engagement advantage in the fighter have yet to be developed, although one of the QOT&E missions provided a promising example of an air-to-air tactic reliant on Link 16 information exchange.

The data from DT, combined DT/OT, QOT&E, and MS-OT included 337 FDL flight hours on all models of the F-15 fighter. While the data indicated that the FDL demonstrated a Mean Time Between Critical Failure (MTBCF) of 84 hours, it did not demonstrate the requirement of 1,000 hours MTBCF. The demonstrated MTBCF did exceed the F-15 Class 2 Joint Tactical Information Distribution System MTBCF of 17 hours and the FDL demonstrated a mission-ready Operational Availability of 98 percent. QOT&E was also unable to resolve the evaluation of logistics supportability. AFOTEC is conducting FOT&E to resolve reliability and logistics supportability issues.

The F-15E FDL Link 16 implementation was certified by the CAF as interoperable with other Air Force Link 16 host platforms. The evaluators stated, "No significant software problems were identified." The JITC post-certification test Joint Analysis Review Panel, consisting of voting members from all Services and the National Security Agency, voted unanimously to grant interoperability certification to the F-15E FDL implementation. The test results indicated some minor problems in message implementation, which were documented and sent to the Air Force for resolution.

The Information Assurance vulnerability assessment indicated that the processes and procedures in place at the Data Link Solutions factory, Government Test Facility, depot, and the Air Force Link 16 network design facility, including the alternate design facility, were at low risk to the integrity and availability of FDL Link 16. The report also stated that safeguards were in place to mitigate these risks. DOT&E still has some concern with one of the methods employed to transmit Link 16 network design and updates to airbases, and has requested the Air Force to investigate and report potential mitigations.

The BIT demonstration conducted on April 19, 2000 indicated that the F-15E host would not recognize 37 percent of the faults sent to it by the FDL terminal. Data Link Solutions, the FDL terminal developer, was present at the demonstration and able to understand and diagnose the cause. A fix to the terminal BIT was provided in a subsequent FDL software release and successfully re-tested in July 2000.

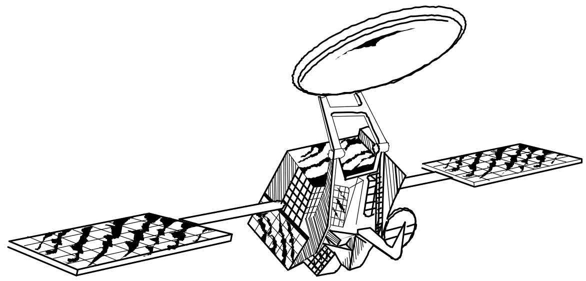
CONCLUSIONS AND RECOMMENDATIONS

FDL completed operational testing in 2000, and was evaluated as operationally effective and suitable. FDL provides the F-15 fighter with a robust and joint interoperable communications link capable of contributing to a common relevant operational picture. However, the full implications of this capability on precision engagement and dominant maneuver have not yet been realized due to the immaturity of concepts of operation, tactics, and stove-piped implementation of Link 16 into various host platforms by developers that may not appreciate the information needs of off-board host platforms. Future enhancements of FDL Link 16 implementation into the F-15 fighter aircraft include imagery, sensor cueing, and high throughput. The effect of these enhancements on Joint Vision 2020 operational concepts, Joint and Multinational Interoperability, off-board platforms, and overall Link 16 design architecture must be evaluated.

FDL development was spiral in nature, incorporating more host platforms, additional requirements, capabilities, and graduated testing throughout the relatively short EMD phase. Despite these challenges, a product the user clearly desired was developed and fielded. The key was the process. FDL development and the test program featured open visibility and communications between Program Management, the users (Air Combat Command and ANG Requirements), the two contractors, developmental testers, AFOTEC, and OSD. The FDL program is now actively sharing its successes, failures, processes, and lessons learned with other Link 16 integration programs including the F-16, F/A-18, B-1, and B-2 bombers.

Participation of Total Force elements, the ANG in this program, greatly contributed to FDL design and test effort. ANG provided additional flight missions to support DT and the evaluation of operational effectiveness and suitability issues. The ANG avionics maintenance technicians supported the maintenance remove and replace tests. Also, the ANG was able to source a number of ANG F-16 aircraft to support the test as simulated adversaries with advanced capabilities.

GLOBAL BROADCAST SERVICE (GBS)



DoD ACAT ID Program		**Prime Contractor**
Total Number of Systems:	493	Raytheon Systems
Total Program Cost (TY$):	$458M	
Average Unit Cost (TY$):	$928K	
Full-rate production:	4QFY02	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Global Broadcast Service (GBS) will augment and interface with other communications systems and provide a continuous, high-speed, one-way flow of high-volume data, audio, imagery, and video information streams to deployed and garrisoned forces across the globe. GBS will support routine operations, training and military exercises, special activities, crisis response, situational awareness, weapons targeting, and intelligence. GBS will also support the transition to and conduct of operations short of nuclear war. GBS is designed to provide the warfighter with the ***information superiority*** necessary to act inside the decision cycle of the adversary and execute ***precision engagement*** as the ***dominant maneuver*** force during activities leading up to and during armed conflict.

GBS consists of a space segment, fixed and transportable transmit suites, and fixed and transportable receive suites. The space segment of the current phase of GBS consists of three Ultra High Frequency Follow-On (UFO) satellites, each modified with four GBS transponders and an undetermined number of leased commercial satellites. Transmit suites build broadcast data streams from various sources of information, including command, weather and intelligence agencies and commercial television programming such as the Cable News Network. They manage the flow of selected information through the uplink broadcast antenna to the orbiting satellites for broadcast to the appropriate theaters of operation. The receive suites reverse this process and distribute the information to the appropriate end users within selected areas of operation.

BACKGROUND INFORMATION

The Conduct of the Persian Gulf War-The Final Report to Congress, April 1992, highlights the limited ability of current military and civilian satellite communication systems to provide responsive, high-capacity communications to deployed mobile tactical units. GBS is designed to fulfill that need.

The GBS acquisition strategy was conceived as a three-phase program based on an evolutionary system design supported by commercially available technology. The program is currently in Phase II. GBS Phase I, conducted from FY96-FY98, was used to develop the user requirements and concepts of operations. GBS Phase II, scheduled for completion in FY06, will develop near-worldwide GBS core operational capability and further refine operational requirements and employment concepts. It is expected that most of the hardware design will remain relatively stable throughout Phase II; however, substantial hardware re-design has been necessary to meet military requirements. GBS Phase III, scheduled to begin for FY06 and beyond, is currently undefined.

Milestone II for the GBS Phase II system occurred in November 1997. In June 1999, the GBS Joint Program Office submitted a Program Deviation Report to the Milestone Decision Authority notifying him of a breach in the Acquisition Program Baseline (APB) schedule. The schedule breach is attributed to construction delays at the Sigonella, Italy transmit site, delay of the launch of UFO-10, as well as problems with transmit suite software and transportable/fixed receive suite design. On April 27, the Joint Requirements Oversight Council (JROC) (JROCM 080-00) directed the Air Force to develop an incremental strategy to initially field and test GBS terminals and revise or clarify the ORD with respect to the deferred capabilities that would be incrementally fielded. The JROC approved this incremental strategy on June 27, (JROCM 111-00) and a revised APB was submitted in July 2000.

The system will be incrementally fielded with three successive software builds (2.1, 2.2 and 2.3) during FY01. IOC for this core system is projected for 4QFY01 and Milestone III (previously scheduled for 1QFY00) slipped to 3QFY02. The deferred capabilities of full broadcast history, classified video, and remote enable will be fielded in two additional builds, (2.4 and 2.5) with an IOC for this upgraded capability projected for 4QFY02. Finally, the more lightweight rugged TGRS configuration will be released in FY03, with an IOC for this configuration projected for 4QFY03.

TEST & EVALUATION ACTIVITY

Phase I demonstrated that the core technologies required to execute the GBS program have been developed and that a GBS-like capability has military utility.

The Phase II GBS TEMP is currently being rewritten to reflect the incremental fielding and testing requested by the JROC and recently approved by the MDA. Submission of operational test plans will follow shortly after approval of the TEMP. A Combined Test Force was formed to coordinate the planning of all GBS system testing. Members of the Combined Test Force include representatives from the using commands, the program office, the development contractors, and the Army, Navy, Air Force, and Marine Corps OTAs. The OTAS participated in developmental testing as members of the Combined Test Force and have provided feedback to the development community. Developmental test events have included factory acceptance tests, site acceptance tests, Y2K tests, shipboard receive suite tests, and on-orbit tests of UFO satellites 8, 9, and 10.

UFO satellite 8, the first UFO satellite equipped with a GBS payload, was successfully launched from Cape Canaveral Air Station on March 16, 1998. The satellite was declared ready to support GBS transmit and receive suite testing in the Pacific region in June 1998. The combined DT/OT, which was to begin at that time, was postponed because of software development and security-related issues impacting the fixed transmit suite in Hawaii and fixed receive suites in Korea. These tests were conducted from October 1998-January 1999 after the Program Office evaluated and accepted the contractor's fixes, revised master schedule and development approach. However, testing revealed numerous performance, quality, reliability and durability problems with both the fixed and transportable ground receive suites. Both have undergone a complete re-design since that time.

The original plan was to deliver and test the ground software in three increments of increasing maturity. There will now be an incremental DT/OT phase in conjunction with each hardware and software release. MOT&E will test the configuration of Build 2.3, which should contain the core capability approved by the JROC. Although MOT&E will use Build 2.3, DOT&E has requested that Builds 2.4 and 2.5 be tested in accordance with its "Guidelines for Conducting Operational Test and Evaluation for Software-Intensive System Increments," and that these results reported to DOT&E for inclusion in the B-LRIP report. The purpose is to mitigate risk by demonstrating that Builds 2.4 and 2.5 achieve desired capabilities and require no hardware modifications before the Milestone III full-rate production authority is granted. Finally, there will be an FOT&E following release of the lightweight rugged TGRS.

TEST & EVALUATION ASSESSMENT

The software and hardware problems have been significant. The strategy of having transmit and receive suites in place for test and within the footprint of each of the three UFO/GBS satellites in time to start system testing immediately after satellite checkout has only been marginally executable due to various schedule slips. The tests are being performed, but the satellites will be on-orbit for many months before system testing begins. As GBS equipment delivery dates and locations change, the test program (including detailed test plans) must be regularly updated to keep pace with the changes.

The GBS program continues to encounter and resolve many technical and operational issues. DOT&E views the following issues as the most challenging in the months before MOT&E:

- *Tracking contractor delivery of Build 2.1*. The proposed incremental fielding and test schedule will only be achievable if there truly has been a shift in the caliber of contractor performance, which will be demonstrated by an on-time delivery of a Build 2.1 system before the end of 1QFY01.

- *Providing necessary broadcasts during the split fielding of Build 2.1 in the Atlantic and Build 2.2 in the Pacific*. This creates certain conflicts for the Navy, which will require Build 2.2 broadcasts on both coasts during its installation phase. The potential use of the transportable Theater Injection Point for the Atlantic broadcast creates separate scheduling problems for the Army.

- *Coordinating schedule slips with the Navy installation schedule*. Navy participation is essential to successful MOT&E. However, installation of shipboard terminals requires careful coordination between hardware availability dates and dates of scheduled maintenance.

- *Finalizing concepts of operations and agreement among competing Theater Commander in Chiefs' (CINCs).* Finalizing concepts of operations and agreements among CINCs' regarding the appropriate use of GBS and sharing of satellite broadcast resources to support conflicting regional needs in time of crisis may be a challenge.

RECOMMENDATIONS

DOT&E supports the incremental fielding and testing as approved in the current APB. This assumes that MOT&E is a capstone event that includes all major system components and demonstrates full core system functionality and interoperability. Test results for software builds 2.4 and 2.5 must be presented to DOT&E prior to Milestone III to mitigate risk by demonstrating that no hardware design changes will be required to support these builds.

The GBS Program Office should:

- Monitor contractor delivery of software builds and be prepared to restructure the success-driven test schedule if the contractor does not demonstrate his ability to deliver a fully functional final product.

- Continue to work aggressively with the Information Dissemination Management office to ensure that the appropriate architectures are in place to support a successful MOT&E and terminal fielding.

- Continue to work with the operational user community to finalize the concepts of operation, which define how the GBS system will be used in the field.

The Combined Test Force should:

- Complete the rewrite of the TEMP and expedite the signature coordination process.

- Complete individual and combined Service operational test plans associated with MOT&E. Provide plans and associated briefings to DOT&E as soon as possible.

- Track training to assure that there will be sufficiently trained operators at the necessary skill levels to operate all necessary receive and broadcast suites.

JOINT AIR-TO-SURFACE STANDOFF MISSILE (JASSM)

Air Force ACAT ID Program		**Prime Contractor**
Total Number of Systems:	2,400	Lockheed Martin Integrated Systems
Total Program Cost (TY$):	$1189.0M	
Average Unit Cost (TY$):	$495K	
Full-rate production:	4QFY03	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Joint Air-to-Surface Standoff Missile (JASSM) is a ***precision engagement*** weapon that integrates the standoff delivery accuracy and effectiveness required to kill critical enemy targets with the necessary technologies to ensure high missile survivability. This precision engagement capability will enable joint U.S. and combined allied forces to conduct sustained and synchronized operations from dispersed locations to ensure ***dominant maneuver***.

The JASSM Missile System is an Acquisition Category 1D effort to develop a survivable precision cruise missile capable of launch from outside area defenses to kill hard, medium-hardened, and soft/soft-distributed targets. The weapon is required to attack both fixed and relocatable targets. The threshold integration aircraft are the F-16 (Block 50) and B-52H. Although carrier operability remains a Key Performance Parameter, the Navy F/A-18 E/F has been re-designated as an objective platform. The Navy will determine the schedule for integration onto the F/A-18 E/F.

The Key Performance Parameters for the system are: Missile Mission Effectiveness (expressed as a mission-level measure of overall ability to kill a defined target set), Missile Range, and Carrier Operability. Currently, Navy funding issues will prevent carrier operability being evaluated during IOT&E. The program office developmental concept subordinates all other operational requirements to potential contractor performance/cost tradeoffs to achieve the best value weapon for the service users. These cost-performance trades are to be defined through continued and open interaction between the service users, the program office, the OTAs, and the prime contractor. The program requires the contractor to deliver a fully warranted, all-up round for threshold price of less than $700 thousand each (BY95$). The current average unit procurement price is $323 thousand (FY95), well below the objective price of $400 thousand each (FY95) and a 15-year bumper-to-bumper warranty.

BACKGROUND INFORMATION

Seven contractors initially submitted concept study proposals for the program. During this time of technical build-up, prior to the release to industry of the request for proposal, intense intellectual interaction took place between the contractors and the government team. This open interaction and continued aggressive competition in performance and cost assessment are the keystones of the program office strategy. The final competition phase was between two participants in a Program Definition-Risk Reduction (PDRR) phase. Lockheed Martin and McDonnell Douglas (a wholly owned subsidiary of Boeing) were the prime competing contractors for the PDRR phase. Lockheed Martin was down-selected as the winning contractor in April 1998.

The program is currently in EMD. Developmental testing began in 3QFY00. The combined DT/OT test phase will begin in 4QFY01 with mission DT-5. Dedicated Operational Flight Test will begin in 3QFY02. An LRIP decision is scheduled for 1QFY02. The full-rate production Milestone III decision is scheduled for 2QFY03.

During PDRR, Congress directed the Air Force and Navy to perform an updated Analysis of Alternatives (AOA) to determine the relative value of JASSM versus a proposed variant of the Navy Stand-Off Land Attack Missile-Expanded Response Plus (SLAM-ER+). The results of the AOA substantiated the continued requirement for JASSM.

A November 9, 1998 Milestone II Acquisition Decision Memorandum (ADM) approved JASSM entry into EMD and LRIP entrance criteria. Additionally, the ADM approved adding $97.5 million to fund a 6-month EMD schedule extension to reduce overall program risk. As a result, LRIP moved to January 2001, Milestone III moved to July 2002, and B-52H Required Assets Available moved to 4QFY02.

In September 1999, SAF/AQ directed the JASSM program office to re-structure the program master schedule and delay LRIP go-ahead from January 2001-November 2001. This decision was driven by several technical delays in development. These delays were the result of several factors:

- Teledyne engine development was progressing slower due to design changes to the engine main bearing, digital fuel control, and delays in the improved engine compressor. The impact of these delays was an unrecoverable 3 months delay.

- Key subcontractors are behind schedule due to outer missile mold line changes made by Lockheed Martin. These design changes resulted from anomalies discovered during a JASSM jettison test from an F-16.

- Changes to the outer missile mold line also drove changes to the pitot static/air data system. As a result, two additional DT flights are now required to calibrate the air data system.

The approved LFT&E strategy for JASSM does not include any dedicated live fire test activity. Instead, the information needed to support the eventual Live Fire lethality evaluation will be derived from contractor-conducted tests and from combined DT/OT and IOT&E attacks of representative targets by missiles equipped with live warheads. A combined DT/OT test phase will begin in 1QFY02.

TEST & EVALUATION ACTIVITY

DOT&E, AFOTEC, OPTEVFOR, the program office, and the contractor formulated a mutually acceptable strategy that: (1) incorporates early OT involvement; (2) makes early and continued use of modeling and simulation to gain T&E efficiencies; (3) takes advantage of planned developmental test activity to reduce the operational test matrix; and (4) incorporates operational units into OT&E strategy to minimize the time required to train these operational units following fielding of the JASSM system.

DOT&E and the service OTAs have been especially active in defining the scope of the overall combined test strategy and assessing the program for opportunities to accelerate OT&E and LFT&E through integrated DT/OT events, where prudent. The JASSM Program Director and the Service test agencies have supported this effort. A key facet of the Program Director's test strategy is that there will be no government-directed developmental T&E of the system. The contractor is responsible for the planning and execution of the DT phase of the program. While the government has a test support role for test aircraft, test ranges, test instrumentation, and so forth, the overall developmental test responsibility resides with the prime contractor. This program supports combined developmental and operational test demands, and eventually leads into independent government IOT&E. This high level of early OT&E interaction with the developer is in response to the joint program office's desire to maximize OT participation in the combined phases in an effort to satisfy OT&E objectives as early as possible.

Three significant flight test events occurred in FY00. Early in the fiscal year, a prototype pre-production JASSM flight test vehicle (FTV-3) was launched from an F-16 aircraft and successfully flew for over 20 minutes. This weapon flew the prescribed flight path using INS/GPS guidance to missile impact (missile IR seeker not active).

Later in the year, the initial release of a production configuration JASSM separation test vehicle (STV-1: non-powered missile) was successfully launched from an F-16 aircraft. Following a clean separation, the missile's wings and tail fin deployed, the strake wedges separated, and stable, controlled flight was achieved. The data show that the missile maneuvered as programmed, and a bomb impact signal was transmitted prior to missile impact in the designated target area. The strake wedges are mold line fixes that directly address the aerodynamic handling anomalies seen in earlier tests.

On September 20, 2000, the first launch of a production configuration JASSM all-up round occurred at the Gulf of Mexico Test Range. The missile flew aerodynamic maneuvers over a pre-planned, controlled route to obtain flight data to calibrate the missile's air data system. The missile was equipped with a flight test boom and flew to impact using INS/GPS guidance (IIR seeker not used in terminal area). However, after 9 minutes of flight the missile impacted the water. Only 25 percent of the planned mission was completed. The Program Office believes it has identified the problem as a malfunctioning fuel control valve and is working to make corrections. The upcoming flight test schedule remains unchanged at this time.

Throughout FY00, the JASSM Automated Target Correlation (ATC) IIR seeker was primarily tested using the Missile Avionics Simulator (MAS), which is a UH-1 helicopter with production JASSM navigation and seeker hardware mounted externally in a pod. The MAS system was used to evaluate seeker performance and ATC algorithms in a number of different climatelogical and diurnal conditions. Approximately 80 test flights were flown.

Additional flight testing conducted during FY00 consisted of the release of jettison test vehicles in production configuration from the two threshold aircraft (F-16, B-52). Other tests were conducted to obtain SEEK EAGLE data for F-16 certification, including aircraft stability and control, aircraft flutter and loads, and aircraft fuel tank jettison.

Ground-based testing in FY00 included bare warhead sled and arena testing to meet Live Fire Test and Evaluation objectives, insensitive munitions testing on both bare warhead and all-up rounds, and functional ground testing using a production engineering test vehicle.

TEST & EVALUATION ASSESSMENT

There are four areas of concern: (1) The Teledyne T-407 engine; (2) the validity of proposed models and simulations to accurately predict missile behavior; (3) the adequacy of predicting missile mission effectiveness using a small number of assets against a sub-set of the total target list, and (4) missile lethality. Operational Test and Evaluation are addressing the first three issues while Live Fire Test and Evaluation is addressing the fourth more specialized area.

First, the T-407 engine is being re-designed to extend storage life, recycle fuel, and possibly to extend the missile's range. The re-designed engine's performance is yet untested in an all-up round in flight scenarios.

Second, the ability of models and simulations to accurately predict missile behavior is undemonstrated. Regarding multiple missile hits to the same target, the models do not adequately characterize the target state after the first missile hit, rendering predictions of subsequent hits insoluble. Additionally, the models appear to not characterize target materials well, resulting in very curious results, such as the missile increasing speed as it travels through concrete.

Third, missile effectiveness is predicated on the requirement that missiles will be fired at each target until the target is damaged or destroyed to the required level. In operational testing, missile effectiveness will be predicted by firing only against a sub-set of the total number of targets delineated in the requirements documents. Fewer targets means fewer test assets. DOT&E perceives that the number of test assets is minimally adequate, at best, to predict missile effectiveness, and only if the observed failure rate is very small. The program office has assured DOT&E that additional missile assets will be made available, if required, to ensure that the missile effectiveness requirement can be properly evaluated. In addition, DOT&E will continue to monitor the evaluation of missile aerodynamics and the placement of the air data system.

Fourth, in the lethality area, the principal Live Fire-related activity in FY00 was warhead qualification testing, which included hazard assessment testing, two arena tests and sled tests to assess the ability of the re-designed warhead casing to withstand aging, temperature cycling, and vibration, and to undergo moderate reactions to cookoff testing. DOT&E oversaw two arena tests in which the warheads were detonated statically in a vertical position to gather blast and fragmentation data to support model validation and Joint Munitions Effectiveness Manual effectiveness estimates. Sled testing had been planned for completion in FY00, but correcting fuze functioning anomalies will cause the final four tests to slip into FY01.

Once the root cause of the fuze problem was diagnosed and corrected, the fuze was fired successfully from a Howitzer to simulate the actual environment that it would see. Following the howitzer testing, the contractor repeated the December 1999 test conditions, and the warhead perforated the concrete target and the fuze functioned properly. Thereafter, the contractor completed the fourth and final bare warhead sled test, and the performance expectations of the warhead and fuze were met. The final four sled tests of the warhead installed in a simulated missile body are expected to occur in early CY01. These tests will address fuze performance in a delay mode after perforating concrete targets, and in a non-delay mode upon soil impact when attacking surface targets. Fragmentation data after detonation will also be gathered.

The program office completed its high-fidelity construction of full-scale bunker targets and other selected soft and distributed targets. The targets, which will be attacked during DT/OT and IOT&E flights with live warheads, are located at White Sands Missile Range (WSMR) and Tonapah Test Range. The first target to be attacked with a live warhead will be a soft surface target at WSMR in April 2001.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

The problems encountered with the fuze highlight the need to thoroughly test every component of the warhead assembly to verify proper performance over a range of environments and impact conditions.

The construction of realistic targets for DT and OT launches of missiles supplied with live warheads should provide a clear indication of JASSM's lethality against its expected target classes.

JASSM is an acquisition reform program with no government-directed developmental testing. The program progresses directly from contractor testing to OT&E. This acquisition reform initiative required the successful early involvement on the part of the operational test community. DOT&E and AFOTEC early involvement in the program, during the request for proposal stage, was essential in laying the foundation for data collection during the later portions of the contractor-led DT test phase. The joint program office has created an environment that fosters this early interaction.

JOINT DIRECT ATTACK MUNITION (JDAM)

Air Force/Navy ACAT ID Program		**Prime Contractor**
Total Number of Systems:	62,000 Air Force 25,500 Navy	Boeing-St. Louis, MO
Total Program Cost (TY$):	$2590.9M	
Average Unit Cost (TY$):	$20K (Est.)	
Full-rate production:	2QFY01	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Joint Direct Attack Munition (JDAM) is a low cost, autonomously controlled, adverse weather accurate guidance kit for the Air Force/Navy 2,000-pound MK-84 and BLU-109 general-purpose bombs and the 1,000-pound MK-83 bomb. There are no planned design changes to the bombs (casing metallurgy, explosive fill, fusing mechanism, etc.), but the existing inventory weapons will be configured with JDAM guidance kits and accessories. The guidance is accomplished via a Global Position System (GPS) aided Inertial Navigation System. Actual weapon launch will occur when the aircrew has flown the aircraft into the weapon Launch Acceptability Region (LAR). The LAR is the three-dimensional area in space in which the weapon may be released to fly directly to a selected target on a pre-determined bearing.

The JDAM kit will yield delivery accuracy of 13 meters when GPS is available and less than 30 meters when GPS is absent or jammed. JDAM is designed to be employed by a variety of fighter/attack and bomber aircraft, allowing ***precision engagement*** from all altitudes under adverse environmental conditions. The primary aircraft for integration of the 2,000-pound JDAM will be the B-52H and the F-18C/D. The 1,000-pound JDAM will be tested and integrated on the F-18C/D, AV-8B, and F-22.

BACKGROUND INFORMATION

JDAM was designated a Pilot Program in accordance with the Federal Acquisition Streamlining Act of 1994, which authorizes relief from numerous DOD regulatory requirements. However, Title 10 OT&E and LFT&E statutory requirements have not been waived. JDAM successfully completed a Milestone I review in October 1993 and entered an 18-month DEM/VAL source selection phase (McDonnell Douglas vs. Lockheed Martin). In October 1995, the Air Force selected McDonnell Douglas Aerospace as the winning JDAM contractor for Phase II EMD and production. Selection was based on overall performance, design, and cost. JDAM was removed from OSD live fire oversight in November 1993. The lethality and survivability of both the Mk-84 and BLU-109 bomb bodies were well documented.

In fall 1994, USD(A&T) approved a plan to accelerate the JDAM program by approximately 18 months to get precision guided munitions into the field at the earliest possible date. The April 1997 JDAM LRIP decision approved the procurement of 937 MK-84 and BLU-109 2,000-pound kits in Lot 1, representing approximately 1 percent of the total planned buy. In January 1998, USD(A&T) approved the delay of Milestone III to 3QFY99, and added a second LRIP for JDAM. In May 1998, the LRIP II decision approved the procurement of 2,202 additional 2,000-pound MK-84 kits. In December 1998, USD(A&T) approved delay of Milestone III until 1QFY00, due to investigation of a bending fatigue problem discovered in the high-speed, low to medium altitude environment, resulting in cracks in the fin shafts in MK-84 tail assemblies carried on the inboard stations of the F/A-18, and added a third LRIP for JDAM. Further delays in completing the development and flight testing of the new pin-lock tail actuator sub-system design necessitated an additional delay for Milestone III. In June 2000, USD(A&T) approved further delay of Milestone III until April 2001, and approved the pin-lock configuration for a fourth LRIP for JDAM. The fourth LRIP will procure an additional 8,163 2000-pound tail kits; 5,073 MK-84; and 3,090 BLU-109 kits. Also, this decision added the F/A-18C/D as a threshold aircraft for the MK-83 due to software development delays for the AV-8B.

TEST & EVALUATION ACTIVITY

Both Air Force and Navy operational test agencies began dedicated OT&E of the 2,000-pound MK-84 and BLU-109 kits in November 1998. Operational testing of friction brake design weapons, including the delivery of 122 MK-84 and BLU-109 weapons from F-18s and B-52s, was completed in August 1999. IOT&E/OPEVAL was completed with testing of ten pin-lock design weapons during the Verification of Correction of Deficiency phase from May-August 2000.

The Navy's F/A-18 served as the threshold fighter and the B-52 served as the threshold bomber during the dedicated IOT&E phase. However, results of concurrent JDAM integration testing on the F-16, B-1, and B-2 will be used to support an informed full-rate production decision. The results of B-2 JDAM deliveries during Operation Allied Force will also be used by DOT&E, as appropriate, to support the Operational Test and Evaluation Report. Integration testing of the 2000-pound JDAM on additional platforms, including the F-14 and F/A-18E/F, began this year.

Developmental testing of MK-83 has begun with ground tests, fit checks, and weapon separation tests. Operational testing of the MK-83 is planned for 2Q01. The scale of testing is expected to be less than testing for the 2000-pound variants due to the high commonality of already tested components. F-18C/D integration is planned for FY01. Integration and OPEVAL on the AV-8B is scheduled for FY02. Integration testing on the F-22 is planned to begin in FY03.

Planning to adapt the JDAM tail kit to the MK-82 500-pound bomb has begun. Developmental flight test is projected to begin on the F-16 and F-18 in FY02 followed by operational flight test.

TEST & EVALUATION ASSESSMENT

JDAM completed operational testing in August 2000. Results are being analyzed based on data from all operational testing, including the pin-lock verification phase. Detailed test results will be reported in the Operational Test and Evaluation Report in early 2001.

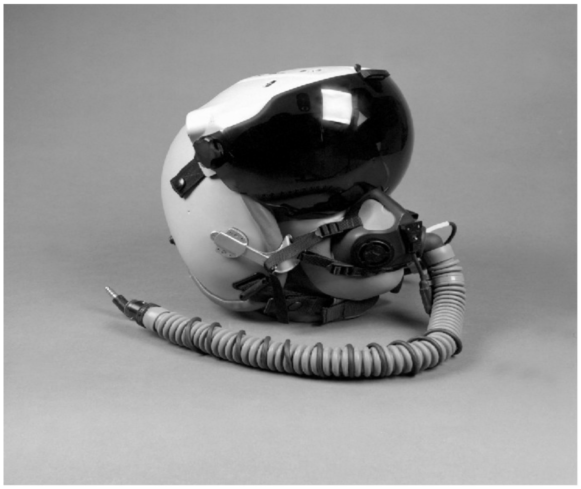
During operational testing, anomalies led to the Air Force decertifying use of the Joint Programmable Fuze (JPF) with the BLU-109 version of JDAM and the Navy decertifying JPF for both the MK-84 and BLU-109. The JDAM/JPF combination did not meet requirements. This impacts JDAM's airborne re-targeting capability due to the inability to change fuze settings of alternative fuzes in flight. Action has begun to resolve this deficiency. Follow-on operational testing will be required when a solution has been developed.

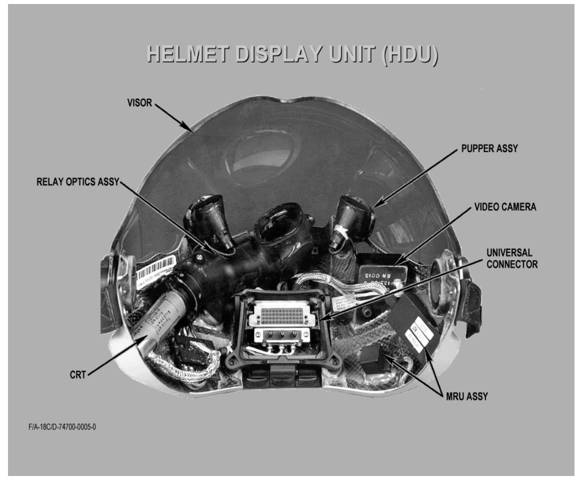
More than 20 JDAMS have been employed in Operation Southern Watch this year. Battle damage accuracy assessment estimates exceed requirements for the weapon impacting the planned target area.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

The sharing of limited resources and assets between multiple test programs led to schedule extension. In particular, for JDAM testing, aircraft programmed and dedicated to the initial operational test allowed for over 120 weapon releases and other test events in a 10-month period. During the pin-lock verification test phase, an unplanned extension of overall operational test, it took nearly four months to accomplish a much smaller data set that included only ten weapon releases. This was due to other programs competing for the same resources, primarily the flight test aircraft F-18C/Dsat China Lake Naval Air Station. The JDAM capable aircraft were deployed for nearly one month in the middle of the test period to support a higher priority test program. To complete the JDAM test, operational aircraft were brought in from the fleet.

JOINT HELMET MOUNTED CUEING SYSTEM (JHMCS)





Air Force/Navy ACAT III Program

Total Number of Systems:	1,720 (w/o FMS or 18C/D buy)
Total Program Cost (TY$):	EMD - $94M// LCC ~ $300M
Average Unit Cost (TY$):	~ $257K (platform dependent)

Prime Contractor

VSI (Major Subcontractor)

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Joint Helmet Mounted Cueing System (JHMCS) uses a modified HGU-55/P helmet that incorporates a visor-projected Heads-Up Display (HUD) to cue weapons and sensors to the pilot. The system relies on a magnetic transmitter unit fixed to the pilot's seat and a magnetic field probe mounted on the helmet to define helmet pointing positioning. A Helmet Vehicle Interface (HVI) interacts with the aircraft system bus to provide signal generation for the helmet display.

This new cueing system will bring significant performance improvement in the Air-to-Air and Air-to-Ground missions. Presently, to engage a threat aircraft or to train targeting sensors on a ground target, the pilot must maneuver his aircraft to align his radar or fixed HUD line-of-sight with that target. The Joint Helmet Mounted Cueing System will allow the pilot to cue onboard systems with the movement of his head and display weapon system symbology while reducing pilot cockpit workload by providing aircraft performance information without the need to physically glance at the instrument panel. That information will now be projected where it will be continually in the pilot's field of view. Increased situational awareness will be realized by providing off boresight target capabilities and reactive threat cueing through integration of cockpit systems. Cueing from systems such as Advanced Targeting Forward Looking Infrared (ATFLIR) and Advanced Electronically Scanned Antenna (AESA) radar will enhance precision guided munitions employment. The projected firepower from Joint fighter aircraft utilizing this key warfighting improvement will be a major contributor to the ***Joint Vision 2020*** concept of ***precision engagement***.

BACKGROUND INFORMATION

The Joint Mission Need Statement dates back to January 1994, with Milestone II decision to enter EMD on December 10, 1996. The Operational Assessment began in August 1999 and was completed in February 2000, resulting in a successful Low Rate Initial Production decision on May 25, 2000. OPEVAL in the FA-18E/F is planned for 1QFY02 followed by Milestone III in April 2002.

The JHMCS system will be employed in the FA-18C/D/E/F, F-15C/D, F-22 and F-16 Block 40/50, with a design that is 95 percent common to all four platforms. When used in conjunction with the AIM-9X missile, the High Off-Boresight features of each system are maximized. Presently, JHMCS is slated to IOC in time to make the second deployment of FA-18E/F in FY03, and the third deployment should add the AIM-9X in FY05. F-15 IOT&E is scheduled for 4QFY01 with IOC scheduled for 3QFY03. The Requested Assets Available (RAA) for USAF F-16 is scheduled for 4QFY03. The F-22 is scheduled to IOC in December 2005.

Initial DT results using the FA-18C/D and F-15C found significant reliability and maintainability issues (particularly with the FA-18C/D) with the connector between the helmet and the aircraft—called the Helmet Vehicle Interface. It was also recommended that pilot training be conducted on the visor focal length issues and cockpit scan practices prior to flying with the new helmet. The Operational Assessment on the FA-18C/D was awarded a potentially effective and a potentially not suitable report due to numerous breaks in the HVI with long fix times and an usually high BIT false alarm rate. Initial F-15C flight tests found that the legacy computer throughput provided slow support to the JHMCS. This computer latency problem, coupled with the F-15C high Analyses Of Alternatives buffet affected target designation performance. Significant improvement was made when the AIM-9X received a software change to expand the field of regard, thus allowing locks in all flight conditions.

Helmet Vehicle Interface reliability was increased by replacing the failure prone coaxial cable with twisted shielded pair wiring. The in-line release connector disconnects were corrected by re-routing the cable and adding an exo-shell to eliminate side load effects within the cockpit. The maintainability issue was corrected by re-designing the FA-18E/F connector to allow the ability to re-mate, as in the F-15C connector, and to provide limited O-level repair capability.

The Joint Helmet Mounted Cueing System is currently under a DOD IG audit, which began in June 2000 and is due to outbrief in 1QFY01.

TEST & EVALUATION ASSESSMENT

The Joint Helmet Mounted Cueing System is on track and has demonstrated few integration issues with the AIM-9X system with the FA-18 and F-15 platforms. Performance data acquired using AIM-9X captive-carry missiles and missile live-fires are being analyzed. Early involvement and identification of cockpit/helmet interface problems has corrected this reliability issue. No major performance shortcomings are envisioned at this time.

JOINT PRIMARY AIRCRAFT TRAINING SYSTEM (JPATS)

Joint AF/Navy ACAT IC Program		**Prime Contractor**
Total Number of Systems:	782	Raytheon Aircraft Company
Total Program Cost (TY$):	$4287M	
Average Unit Cost (TY$):	$5M	
Full-rate production:	2QFY01	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Joint Primary Aircraft Training System (JPATS) is a set of primary flight training devices tailored to meet U.S. Air Force (USAF) and U.S. Navy (USN) aircrew requirements. The principal JPATS mission is to train entry-level USAF/USN student pilots in primary flying skills to a level of proficiency at which they can transition into an advanced pilot training track leading to qualification as military pilots, navigators, and Naval Flight Officers. JPATS is designed to replace the USAF T-37B and USN T-34C aircraft and their associated Ground-Based Training Systems (GBTS).

The Joint Primary Aircraft Training System consists of the T-6A Texan II air vehicles, simulators and associated ground-based training devices, a training integration management system, instructional courseware, and contractor logistics support. The Services will acquire common aircraft and the remaining components will be as common as possible. Logistics support will be tailored to each Service's maintenance concept.

The ground and air components of JPATS support the ***Joint Vision 2020*** objective of preparing joint warriors to meet the challenges of future battlespaces by ensuring that they are properly trained using a common training platform and curriculum.

BACKGROUND INFORMATION

In December 1990, the Joint Requirements Oversight Council validated the JPATS Mission Need Statement. Operational requirements were subsequently codified in the JPATS Operational Requirements Document (ORD). JPATS was designated a Defense Acquisition Pilot Program in the 1994 Federal Acquisition Streamlining Act, becoming the first aircraft program to be selected.

An EOA was conducted during the Source Selection Flight Evaluation from July-October 1994 at Wright Patterson AFB. Seven candidate aircraft were evaluated, each completing 13 flights. Milestone II was held in August 1995, and the Raytheon Corporation was awarded contracts for Lots 1 and 2, with additional priced options through Lot 8 in February 1996. A Milestone II TEMP was approved in July 1995. The ORD was signed in December 1996 and a draft ORD, dated April 2000, is currently in coordination. Following a source selection process conducted by Raytheon, the GBTS subcontract was awarded to the Flight Safety Services Corporation in April 1997.

Aircraft tests have included developmental testing by Raytheon, Qualification Test and Evaluation (QT&E) addressing joint service requirements led by the Air Force Flight Test Center, and Federal Aviation Administration (FAA) certification of commercial components. In March 1997, DOT&E approved a plan for a three-phase OA during QT&E. The first phase of the OA was completed in May 1997. It focused on four key areas: (1) effectiveness and suitability; (2) programmatic voids; (3) program documentation; and (4) the ability to support the aircraft Multi-Service Operational Test and Evaluation (MOT&E). Flight assessment consisted of ten flights and 16 flight hours, conducted from April 22-May 1, 1997, in a non production-representative prototype aircraft. A human factors ground assessment, conducted from May 6-7, 1997, involved 13 Air Force and 15 Navy pilots. Both assessments were conducted at Raytheon Aircraft Company.

Phase II of OA flight testing began in January 1998, with four of ten planned flights completed in the prototype aircraft. Production delays on the EMD article delayed the first flight until July 1998. The remaining six flights of Phase II were deleted due to prototype unavailability. Developmental testing proceeded. Phase III of the OA was completed in April 1999. The T-6A aircraft was determined to be potentially operationally effective and suitable.

An updated TEMP was approved in January 1999. The TEMP was revised to reflect changes in the ORD, delays in the development and production schedules, and updated GBTS information following selection of a GBTS contractor Flight Safety Systems. That revision contained a more detailed plan for testing the requirements of all GBTS components and the full range of air vehicle missions described in the ORD.

Delays in achieving FAA certification resulted in a breech of the Acquisition Program Baseline schedule so the program was re-baselined in February 1999. At that time, the Milestone III date was moved from January 2000 to June 2000. Subsequently, it was further delayed to February 2001 because of engine anomalies and an oil cooler rupture. Delays in the development of three key Aircrew Training Devices (ATDs) also delayed their readiness for testing. The start dates of component MOT&E for both the T-6A and the ATDs were moved correspondingly.

TEST & EVALUATION ACTIVITY

The TEMP is currently in revision to support the Milestone III proposed for February 2001.

The AFOTEC test team has been on-site at Randolph AFB conducting MOT&E(A) for the T-6A and in the Flight Safety plant conducting MOT&E(I) for the ATDs. MOT&E(A) consisted of approximately 300 flight hours flown by experienced instructor pilots from the USAF using command (AETC) and operational test pilots from AFOTEC and COMOPTEVFOR. The Joint Primary Pilot Training (JPPT) course syllabus was the basis for mission profiles. Common student errors, those mistakes made by inexperienced students, were employed to determine the viability of the T-6A as a primary student trainer. In addition, deficiencies identified in previous tests were re-evaluated. MOT&E (A) commenced in June 2000. Testing was completed in November 2000.

MOT&E(I), an in-plant operational assessment (OA) of the GBTS, was performed in September 2000. Eighty-three deficiencies were identified and one safety issue was highlighted.

In June 2000, a change in the original operational test was proposed by the Services. Initial plans called for an end-to-end, system-level test to be conducted during the System Level Formative Evaluation (SLFE, a DT&E event) for the integrated GBTS components, scheduled for spring 2001. A proposal to delay the system-level OT&E to Moody AFB in conjunction with the first class of students in June 2001 was proposed. That proposal was accepted in principle. Details will be delineated in the TEMP.

TEST & EVALUATION ASSESSMENT

The environmental control system is still deficient. Adequate cooling of the cockpit has not been demonstrated using a production-representative system in typical operational environments nor does it meet system specifications. Cockpit temperatures near 100 degrees farenheight have been recorded. Four problems are being examined: (1) rapid system cycling; (2) distribution of air in the cockpit areas; (3) reducing the temperature of cooled air; and (4) improving control of louvers for directing airflow. The contractor has determined that the system evaporator is performing well below its anticipated efficiency. Flow through the condenser may be deficient, but that cannot be confirmed until the evaporator problem is resolved.

Although a Milestone III production decision has been scheduled fro February 2001, there are still contractor developmental tests to be completed. Those developmental tests include an icing transition demonstration that would clear the aircraft to fly through 5,000 feet of light rime ice, and fatigue and durability testing (originally prescribed before the award of production Lot 7, now a prerequisite for the Lot 8 award).

The SLFE for the integrated GBTS components is now scheduled to start in January 2001. It will evaluate, for the first time, whether the suite of JPATS GBTS components has the capability to operate as an integrated system. A dedicated period of MOT&E is planned at Randolph AFB in conjunction with the SLFE. This will represent the first opportunity to evaluate, in part, the integrated JPATS, including the aircraft and GBTS, from an operational perspective minus actual students.

The system-level MOT&E(S) at Moody AFB will consist of 17 Air Force and Navy students. Those students will follow the JPPT course syllabus, approximately five to six months in duration.

However, in order to accomplish intended training, all required assets must be in place. It is not apparent that the GBTS will be mature enough nor will there be sufficient numbers of fully qualified instructor pilots by the scheduled start in June 2001. Fleet aircraft reliability is also questionable at this time.

In August 2000 an AETC T-6A aircraft crashed near Randolph AFB. The aircraft was owned by the using command and operated by two of their experienced pilots. One pilot was a T-6A pilot and the other was on an introductory T-6A flight. Both pilots ejected and survived. The Safety Investigation Board report has been released to a limited audience listing a number of recommendations for suggested improvements. The Accident Investigation Board findings indicated that the crash was due to the pilot inadvertently shutting the aircraft down.

CONCLUSIONS

JPATS is the first aircraft pilot program for acquisition reform using a streamlined approach to theoretically reduce the acquisition time required to obtain and field a system. Developmental testing is still not complete, and while operational testing was ongoing, aircraft were delivered to the user. Delivery of any system to the user prior to completion of appropriate testing is never a good situation. The process by how a system is chosen to be a commercial acquisition candidate should be reviewed.

Since the SLFE, MOT&E(O), and the dedicated system-level MOT&E(S) will occur after the proposed Milestone III in February 2001, a supplemental DOT&E B-LRIP report will be sent to Congress upon completion of the system-level test.

JOINT STRIKE FIGHTER (JSF)

Joint ACAT ID Program		**Prime Contractor**
Total Number of Systems:	3,128	Lockheed Martin or Boeing
Total Program Cost (TY$):	$200B	
Average Unit Cost (TY$):	$35M	
Full-rate production:	1QFY09	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Joint Strike Fighter (JSF) Program will develop and deploy a family of strike aircraft by capitalizing on commonality and modularity to maximize affordability while addressing the needs of the Air Force, Navy, Marine Corps, and United Kingdom Royal Navy and Royal Air Force. This family of strike aircraft will consist of three variants: (1) Conventional Takeoff and Landing (CTOL); (2) Aircraft Carrier Suitable (CV); and (3) Short Takeoff and Vertical Landing (STOVL). The focus of the program is affordability: reducing the development, production, and ownership costs of the JSF family of aircraft. The family of JSF variants will provide the Navy with a first-day-of-the-war, survivable aircraft to complement the F/A-18E/F; the Air Force with a replacement for the F-16 and A-10 and complement the F-22; the Marines with a single STOVL platform to replace the AV-8B and F/A-18C/D; and the Royal Navy and Royal Air Force with a supersonic STOVL fighter/attack aircraft to replace the Sea Harrier and GR-7, respectively.

Foreign interest in the program is high, and a number of allies have entered into cooperative agreements to participate in the program. All variants will contribute to the ***Joint Vision 2020*** concepts of ***precision engagement*** and ***full-dimensional protection***. The JSF will be a single-seat, single-engine aircraft capable of performing and surviving lethal strike warfare missions using an affordable blend of key technologies. A high degree of commonality (70-80 percent) exists amongst the three variants. Aircraft sub-systems that will be identical in all three designs include the wing and fuselage structures, engine core, avionics and onboard computers, cockpits, electrical wiring, electronics, flight controls, control surfaces, and fuel tanks. The JSF system consists of the JSF air vehicles and all support training equipment, related facilities, materiel, software, services, and personnel to ensure that the system can accomplish its intended operational role.

BACKGROUND INFORMATION

The purpose of the JSF Program is to affordably develop the next-generation strike fighter weapons system to meet an advanced threat (2010 and beyond), while improving lethality, survivability, and supportability. The JSF Program originated from the Joint Advanced Strike Technology (JAST) program.

A multi-year $2.2 billion JSF Concept Demonstration and Risk Reduction (CDRR) effort commenced in November 1996, with competitive contract awards to Boeing and Lockheed Martin for the CDRR Program. These competing contractors have each built two concept demonstrator flight test aircraft to conduct concept-unique ground demonstrations and continue refinement of their ultimate delivered weapon system concepts. Pratt & Whitney is providing propulsion hardware and engineering support for both Boeing's and Lockheed Martin's ongoing JSF CDRR efforts. The JSF Alternate Engine Program with General Electric continues to develop an alternate engine for production in order to reap the financial and performance benefits of competition.

The EMD program, which will follow CDRR, will be structured to develop the JSF weapon system in a series of block upgrades with successively increasing capabilities. The first three blocks will be intended to achieve the full performance capabilities currently set forth in the Joint Operational Requirements Document. As EMD progresses, the users are expected to require new capabilities for future block upgrades as the strengths and weaknesses of various emerging technologies become apparent.

While survivability has two primary components, threat avoidance and damage tolerance, the JSF focused early on defining its susceptibility requirements (threat avoidance) in terms of radar and infrared signature levels. The vulnerability requirements were raised to the JSF System Program Office over three years ago, but only recently has the program identified engagement probabilities of kill given a hit (damage tolerance) to establish vulnerability and reparability requirements.

The JSF is required to be less vulnerable than the F-16. The aircraft is expected to feature a "not-to-exceed" engagement Probability of Kill (P_k) for aircraft loss or pilot casualties as the result of an impact of a 23mm API/HEI, 30mm HEI projectile, MANPADS threat, or proximity fuzed missiles. JSF susceptibility and vulnerability to directed-energy, chemical, and biological weapons will also be addressed. The design guidelines to reduce the vulnerability of the JSF include redundancy and separation of critical sub-systems, components, lines, and structure. These guidelines also encourage the placement of fuel cells to minimize the ingestion of leaking fuel into the engine inlets. The standard evaluation process for JSF has evolved from the specification of a given vulnerable area against a 30mm projectile to an engagement P_k-based methodology. The goal for aircraft battle damage repair is to be able to repair damage from 23mm hits with organizational maintenance within 24 hours.

TEST & EVALUATION ACTIVITY

DOT&E has continuously participated in JSF OT&E and monitored LFT&E planning activities since June 1995 when it was known as the JAST program. Integrated Product Team meetings are being held to address OT&E and LFT&E. The Combined Test Working Group (CTWG) (a systems test IPT) is responsible for all T&E efforts in executing the JSF CDRR program and planning for the EMD program. The CTWG provides a single point of contact for the member services, OSD, and the weapon systems contractors for all T&E related matters. During the JSF CDRR Phase, competing contractor teams led by Boeing and Lockheed Martin have each built, qualified, and are flying two Concept Demonstrator Aircraft designated the X-32 and X-35, respectively. Rather than being prototypes with full-up systems, these demonstrators will incorporate the engine and outer mold lines of the contractor's JSF design and largely use off-the-shelf systems and avionics. These demonstrators are intended to demonstrate the viability of each contractor's airframe design concept, including the ability to accomplish short take-off, hover and transition to wingborne flight, up-and-away performance, and low-speed handling consistent with landing aboard a carrier. During this phase, each contractor is responsible for planning and executing the ground and flight tests and demonstrations. During the current CDRR phase, government personnel will actively participate in test planning and execution at the discretion of the respective competing contractors. The OTAs for JSF, AFOTEC, and COMOPTEVFOR are conducting an EOA to support the Milestone II decision. During EMD, an integrated test team will perform all developmental testing and OTAs will conduct operational assessments and dedicated OT&E.

During EMD, ground test and flight test aircraft will be built representing all three variants, and will be augmented by full-mission simulators and flying avionics testbed aircraft. The OTAs and DOT&E will continue as active participants in the Combined Test Working Group throughout EMD; and the OTAs as members of the JSF Integrated Test Force, will independently plan, conduct, and report a series of OAs. OTA activity will culminate with the conduct of dedicated OT&E in the FY10 timeframe in support of a full-rate production decision.

LFT&E activities have centered on the development of an LFT&E strategy, transferring applicable background information on LFT&E to the contractors, and ensuring that the appropriate lessons learned from completed LFT&E and Joint Live Fire programs were transferred to the JPO and contractors. A separate Survivability Integrated Product Team (IPT), which includes a DOT&E representative, has been formally established to work on JSF survivability matters as well as the JSF LFT&E Program. Each contractor team separately briefed the JSF Survivability IPT on their proposed designs, survivability, and LFT&E programs.

DOT&E and the Joint Program Office (JPO) have agreed on an LFT&E strategy to evaluate the survivability of the JSF variants. In testimony to the Senate's Tactical Air Combat Subcommittee on March 22, 2000, DOT&E made clear the requirement to conduct full-up, system-level Live Fire testing of at least one variant of the JSF program due to the uniqueness of the aircraft design, new technologies being used in the design, and the inadequacy of modeling and simulation to adequately predict aircraft vulnerability or identify needed design changes. This testing would be coupled with component and sub-system level Live Fire testing of all of the JSF configurations, assuring that those areas which are particularly unique to each aircraft configuration were included in the LFT&E plan. This agreement is based on the current high degree of commonality (70-80 percent) shared amongst the three variants.

This strategy will require waiver certifications and approved alternative LFT&E plans for any variant that will not undergo full-up, system-level Live Fire Testing. The JPO will prepare the waiver request(s) and alternative LFT&E plan(s) for the variant(s) that will not undergo full-up, system-level Live Fire testing and have the necessary certification(s) and approval(s) prior to Milestone II. The TEMP will contain one integrated, overall LFT&E Plan for all three aircraft variants, consisting of the LFT&E program plan for the variant(s) that will undergo full-up, system-level Live Fire testing, as well as the approved alternative LFT&E plan for the variant(s) receiving waivers from full-up, system-level Live Fire testing.

The JSF LFT&E strategy also includes realistic, end-to-end lethality tests of the new gun system. The gun lethality LFT&E Program consists of ammunition lethality characterization tests, followed by actual gun firings from an aircraft engaging targets expected to be attacked in combat. Since realistic end-to-end testing is planned, a waiver from full-up, system-level Live Fire Testing will not be pursued for the JSF gun lethality LFT&E program.

The LFT&E issues in the current TEMP address, in a generic fashion, how the program intends to complete realistic survivability testing of the aircraft and realistic, end-to-end lethality testing of the gun. The TEMP does not provide details that will prejudice any one contractor or divulge proprietary information. This will permit the contractor, using the TEMP as one of its tools, to develop and propose a survivability program plan that will address all of the issues pertaining to their unique designs. The DOT&E staff briefed each contractor team on the LFT&E requirements in June 2000 at each contractor's facility. The briefings were identical and included background information on the evolution of the statute that requires LFT&E, how DOT&E prefers to address LFT&E through a building block approach, and examples of lessons learned through various LFT&E programs. Both contractor teams have prepared preliminary plans for LFT&E and briefed them to DOT&E and the Joint Program Office. Both contractors' proposals are adequate at this point in the program but will be updated immediately following contract award.

Since the JSF is a single-engine aircraft, the vulnerability of the engine is particularly critical for survival. In light of this, DOT&E has recommended for the last two years that the F119 engine, which will be the core for the JSF engine, undergo live fire testing now. Lessons learned from the F-18E/F LFT&E tests on the F414 engine show that engine vulnerabilities uncovered early can be significantly reduced by re-design of either the engine components, the engine bay, and/or the surrounding aircraft structure and components. This year, the JPO submitted a plan to DOT&E to conduct ballistic tests of two critical F119 engine components in 2001: the first stage Integrally Bladed Rotors (IBR) and the second stage IBR. Additional engine components are expected to undergo ballistic testing in subsequent years, and the survivability IPT is working to develop an engine vulnerability program as part of the overall JSF LFT&E program.

TEST & EVALUATION ASSESSMENT

At this stage of the JSF program, the integration of program planning and T&E planning appears to be on a solid foundation. However, in view of the complexity of the program objectives, numerous T&E opportunities and challenges are being, and will likely continue to be encountered.

In support of its commitment for an affordable, highly common family of next-generation multi-role strike fighter aircraft; the JSF program has adopted an iterative approach toward facilitating the Services' development of fully validated, affordable operational requirements. This approach emphasizes the early and extensive use of cost-performance trades. To assess military utility in support of these trades, the JSF program is continuing development of its Strike Warfare Collaborative Environment (SWCE), a baseline-common modeling and simulation environment to ensure consistent models and data bases. The open process for requirements development and the availability of the SWCE provide needed avenues to improve the linkage between test and requirements processes. In addition, the models used in conjunction with the SWCE may prove useful in the T&E process, although experience has shown that the best available models are not always sufficiently credible for T&E needs.

The JSF will have some technological issues that are important to OT&E. The JSF is expected to have significantly improved interoperability and C^4ISR capabilities, as well as a very highly evolved set of sensors, all of which will be highly integrated with the avionics systems. In particular, these systems will provide the JSF with some of its most distinctive and important operational capabilities. Adequately testing these advanced capabilities at an operational mission level will be another challenge to the test program. The design of appropriate metrics and the development of appropriate scenarios and environments will be a long and involved process. Integration of M&S with flight testing holds potential for addressing this issue.

The JSF will employ some new technologies, and these must be identified early in the program so that they can be monitored during the test program. As one example, the method of providing vertical thrust to the STOVL variant will be a significant advance over the current operational systems and thus carries a corresponding risk, and extra attention should be given to this sub-system. Another area that should be given extra attention is the performance and maintenance requirements of the Low Observables (LOs) and other classified capabilities on the JSF, particularly in the shipboard environment. Current LO systems have experienced difficulty after being fielded, and the JSF test program should endeavor to identify these during OT&E so that any required corrections can be completed prior to fielding the system.

Due to the expected high degree of commonality of the three variants, a single integrated test program is planned, which should save both time and money during the test program. As part of their proposals, the contractor test teams have identified test points that will apply to more than one variant so that unnecessary testing is not performed.

Although economy of testing is expected, the JSF is expected to perform many different missions, and the way each service carries out these missions sometimes have subtle but important differences that must be taken into account in OT&E planning. Adequately exploring this range of missions will be another challenge for the JSF test team.

Modeling and simulation is expected to play a large role in the operational evaluation of the JSF. For example, the JSF plans on supplying the Strike Warfare Collaborative Environment (SWCE) as Government Furnished Equipment, while the contractor will provide digital product descriptions (DPDs) of the JSF that will operate within the SWCE. These efforts will provide new opportunities for integrating M&S with flight testing, but they will also raise new issues. For example, the program intends to validate SWCE and to leave the validation of the DPDs up to the contractor. It is not clear at this time whether this will be adequate for DOT&E, or if an independent validation of these components would be justified. Complete government validation of the DPDs would add costs that are not now programmed, and would place demands on the flight test program that are not currently in place.

The ongoing CDRR Phase will allow early test insights into the viability of basic aircraft designs of the competing contractors to meet the requirements of commonality/modularity for an affordable family of multi-Service aircraft. In addition, these aircraft will demonstrate specific short take-off and vertical landing, hover, transition, and low-speed approach characteristics. More challenging to assess during the CDRR Phase will be the contractors' progress in developing the integrated avionics suite that will be essential to the final JSF design, as well as validating needed improvements in operational supportability and the cost of ownership. Improved insights into the risks of integrated avionics may be available prior to the JSF Milestone II decision from the ongoing F-22 program, which is leading the way in facing such challenges. Since both of the competing JSF contractors are key members of the F-22 team, the lessons learned from that program should reduce the risks in similar areas of the JSF. The planning for EMD provides ample opportunities for the conduct of OAs leading up to dedicated OT&E. As the program matures, it will be essential to define specific accomplishments/characteristics that each of the operational test periods can confirm consistent with the event-driven acquisition strategy required by DoD Regulation 5000.2-R and adopted by JSF. The current planning for dedicated OT&E includes 12 LRIP test articles. While this quantity of aircraft is adequate for the conduct of a thorough operational test, it is not too many since three different aircraft configurations must be tested in the accomplishment of a variety of missions.

The LFT&E portion of the JSF TEMP will be written from a high-level perspective; i.e., it will not contain an approach specific to any one design since contract award will not be made until Milestone II (after the TEMP will be submitted). LFT&E issues in the TEMP will have to address, in a generic fashion, how the program intends to complete realistic survivability testing of the JSF, while at the same time not defining it to a level of detail that will prejudice any one contractor. This will permit the contractor, using the TEMP as one of its tools, to propose a survivability program plan/proposal that will address all of the issues pertaining to their unique designs.

There is a risk, however, that if the TEMP is too generic, the competitors might misinterpret the testing requirements and develop a proposal that will not adequately address how real survivability testing will be completed prior to full-rate production. Since down-select is shortly before Milestone II (waiver/alternate LFT&E strategy deadline), a least-cost strategy may not adequately address real testing. This strategy might not gain approval from DOT&E after a contractor (and associated program plan) has been selected, leading to heavily contested testing issues and associated program costs. DOT&E is working closely, as a member of the CTWG, to ensure the TEMP is written to the detail required to prevent this from happening.

The most significant LFT&E issue is whether the program will conduct full-up, system-level testing. The program has not yet committed and is still investigating the waiver to full-up, system-level LFT&E. DOT&E has proposed that the JSF program conduct a full-up, system level test on one of the designs and request a waiver from full-up, system-level testing for the remaining two designs. Additionally, this office has recommended that they pursue a strategy that also includes testing one full-scale test article (possibly the Navy's drop test article) in addition to the required component and sub-system tests.

The LFT&E portion of the JSF TEMP was written from a high-level perspective; i.e., it does not contain an approach specific to any one design since contract award will not be made until Milestone II (after the TEMP will be submitted). LFT&E issues in the TEMP address, in a generic fashion, how the program intends to complete realistic survivability testing of the JSF, while at the same time not defining it to a level of detail that will prejudice any one contractor. This will permit the contractor, using the TEMP as one of its tools, to propose a survivability program plan/proposal that will address all of the issues pertaining to their unique designs.

Both contractor teams have prepared plans for LFT&E and briefed them to DOT&E. Both contractors' plans appear adequate at this point in the program.

DOT&E has on several occasions recommended that the F119 engine should undergo live fire testing now. Lessons learned from the F-18E/F LFT&E tests (F414 engine) show that engine vulnerabilities uncovered early may be reduced by re-design of either the engine components, the engine bay, and/or the surrounding aircraft. Plans were made to conduct some ballistic tests on F119 components during FY01.

There is a risk that a competitor might scale back his current LFT&E plans to gain a cost advantage in the proposal. Down-select is shortly before Milestone II (waiver/alternate LFT&E strategy deadline). A least-cost strategy might not adequately address real testing and the strategy might not gain approval from DOT&E after a contractor (and associated program plan) has been selected. This could lead to heavily contested testing issues and associated program costs. Since there is very little time from receipt of proposals, source selection, and down-select to Milestone II, the issues that such an unsatisfactory plan will raise might not be resolved before the milestone, which is the waiver deadline. DOT&E is working closely, as a member of the CTWG, to ensure the TEMP is written to the detail required to prevent this from happening and the contractors understand DOT&E's interpretation of the TEMP.

An important LFT&E concern is whether the program will conduct full-up, system-level testing. The JSF Program plans to conduct full-up, system-level testing for one variant and to request waivers for the other two variants. Those features that are unique to the two variants will be tested in nearly complete, full-scale test aircraft and components. One of the less-than-full-up specimens will be a drop-test article. Prior to Milestone II, the program will apply for waivers for the two aircraft that will be tested in less-than-full-up condition. The TEMP will contain one Live Fire Evaluation Plan for all three aircraft variants, which will also constitute the Alternative Plan for the two waived variants.

Although both contractors' LFT&E plans appear adequate at this point in the program, there is a risk that a competitor might scale back their LFT&E program plan to gain a cost advantage in the proposal process. A least-cost strategy might not adequately address real testing and the strategy might not gain approval from DOT&E after a contractor (and associated program plan) has been selected. This could lead to heavily contested testing issues and associated program costs. Since there is very little time from receipt of proposals, source selection, and down-select to Milestone II, the issues might not be resolved before the milestone, which is the waiver deadline. DOT&E is working closely, as a member of the CTWG, to ensure the TEMP is written to the detail required to prevent this from happening, and the contractors seem to understand DOT&E's interpretation of the TEMP.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

Based on the complexity of the F-22 program, we anticipate a great challenge in testing and evaluating the effectiveness of sensor fusion in the JSF.

The durability and maintainability of low-observable materials and processes will have to be included in early operational assessments. In particular, in a shipboard environment, maintenance of classified aspects of the system may prove particularly challenging.

The unprecedented high level of interoperability with other systems expected of the JSF will present unique challenges for testing and evaluating.

JOINT SURVEILLANCE TARGET ATTACK RADAR SYSTEM (JSTARS) E-8C AND COMMON GROUND STATION (CGS)

Air Force E-8C ACAT ID Program		**Prime Contractor**
Total Number of Systems:	15	Northrop Grumman
Total Program Cost (TY):	$9.080B	
Average Unit Cost (TY):	$648.6M	
Full-rate production:	1QFY97	

Army CGS ACAT IC Program		**Prime Contractor**
Total Number of Systems:	96	Motorola
Total Program Cost (TY):	$1.2635B	
Average Unit Cost (TY):	$13.2M	
Full-rate production:	4QFY00	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Joint Surveillance Target Attack Radar System (JSTARS) supports ***dominant maneuver*** of joint forces through its contribution of a synoptic battlefield view to operational maneuver commanders. The system's required ability to perform battlefield surveillance, battle management for both air and land component forces, and indications and warnings functions provide the capability to contribute to ***information superiority*** of U.S. and combined forces. JSTARS is intended to meet the operational need for locating, classifying, and supporting ***precision engagement*** of time-sensitive moving and stationary targets.

JSTARS consists of an Air Force E-8C aircraft, an Army ground station, and the data link that connects the two elements. The E-8C is a remanufactured Boeing 707. The basic airframe of the 25 to 30 year old aircraft has been extensively refurbished and updated with the JSTARS radar system, communications gear, data link capability, 18 primary mission workstations, and air refueling capability. The Air Force has chosen to retain the existing basic aircraft engines, flight control, fuel, and hydraulic systems. JSTARS brings the technical capability to perform surveillance through interleaved synthetic aperture radar (SAR) and moving target indicator (MTI) radar modes to the battlefield as well as the capability to integrate battlefield and geographic information into a near real-time picture of the ground battle.

The ground station receives, processes, and displays JSTARS radar imagery transmitted down from the E-8C. The evolution of the Army ground station has progressed from two versions (light and medium) of the earlier Ground Station Module (GSM) to the current Common Ground Station (CGS). CGS is mounted on a High Mobility Multi-Purpose Wheeled Vehicle (HMMWV). It consists of computer workstations, communications equipment, and data link capability to integrate with the JSTARS aircraft, intelligence networks, and national level information sources. CGS is expected to provide the Army ground elements with the capability to prosecute air and land engagement of time-sensitive targets and support the intelligence preparation of the battlefield.

The Joint STARS program office planned a series of block upgrades and modifications for the E-8C. The block upgrades are:

- Block 10 consisted primarily of the Tactical Digital Information Link (TADIL-J) upgrade (TJU) and Y2K compatibility. The primary purpose of TJU was to implement messages to enable the E-8C to transmit ground surveillance information to other TADIL-J equipped command and control and weapons platforms.

- Block 20 consists primarily of the Computer Replacement Program (CRP), which replaces the current five computer system with two commercial-off-the-shelf computers. This facilitates upgrading the E-8's computers in parallel with industry. In addition, new software is added and the existing processor in the radar is replaced.

- Block 30 includes the integration of satellite communications (SATCOM), and an upgrade of this SATCOM to conform to Demand Assigned Multiple Access compliance.

- Block 40 will consist of the Radar Technology Insertion Program (RTIP), which will replace the JSTARS radar, adding several significant enhancements to both the SAR and MTI radar modes. The enhancements are intended to provide almost order-of-magnitude improvements in resolution and area coverage rates for all radar modes.

In addition to the block upgrades, the Air Force has identified numerous supportability improvements aimed at modifying high failure items and components that require significant maintenance, such as the air cycle machine and addressing growing diminishing resource items.

The Army also has a series of planned upgrades for the CGS. CGS block numbers are different than those used for the E-8. The Block 10 upgrade will add connectivity between the CGS and several additional sensors, including the ARL, U-2 aircraft, and Predator Unmanned Aerial Vehicle. This upgrade will also include additional software tools for the CGS operator, such as radar shadow mapping, video query, and multi-mode enhanced target tracking. The remote workstation in the CGS will also be upgraded. The Block 20 upgrade implements the ability to exchange data on the local area network of Tactical Operating Centers. Also, the Block 20 program integrates the Joint Tactical Terminal, which replaces the older Commander's Tactical Terminal. Finally, it is anticipated that a considerable amount of the automated data processing equipment in the CGS will have to be modified or replaced in order to interface with the improved capabilities available from the Block 40 upgrade of the E-8 aircraft.

BACKGROUND INFORMATION

A Multi-Service Operational Test and Evaluation (MOT&E) was scheduled to start in November 1995 and proceed through mid-1996. However, because of operational tasking in support of OPERATION JOINT ENDEAVOR, the system was evaluated during the operational deployment supporting the forces in Bosnia. While the opportunity to assess the system in an operational context was valuable, it presented critical limitations to the scope of the evaluation. The system was only able to demonstrate limited capability in support of joint forces target attack and battle management because of the nature of the air tasking. The E-8C did not meet its overall suitability requirements during the deployment. Without significant corrective action, the system was evaluated as unsuitable to support a high operational tempo conflict. Because of these shortfalls and unresolved issues in MOT&E, OSD directed FOT&E for the E-8C under the oversight of DOT&E.

The Air Force conducted FOT&E on the E-8C, the Regression Test, which focused on operational suitability. The operational suitability of the E-8C was improved during the Regression Test, but serious deficiencies remained.

The GSM program was granted approval in August 1993 for LRIP of twelve medium units to be mounted on standard 5-ton trucks. Prior to the decision, a Limited User Test of the Medium GSM (MGSM) was conducted. MGSMs were subsequently fielded with contingency forces and used as training equipment. In May 1995, the Army approved LRIP of ten light GSMs (HMMWV-mounted) following the completion of a Force Developmental Test and Evaluation in September 1994. With approval of the CGS program in October 1995, thirty-eight CGS LRIP systems were approved.

Initial Operational Test and Evaluation for CGS was conducted in April 1998. The IOT&E revealed serious operational shortfalls in effectiveness and suitability in the CGS. The CGS operators were unable to report on targets to intelligence or fire support nodes in a timely, accurate and complete manner. The operators were unable to discern stationary targets from their background in the SAR mode of the radar. The doctrine, training, tactics, techniques, and procedures for CGS operations were not adequate for operational effectiveness. The benefit of including other sensor feeds in the CGS was not shown. When operating with an E-8C, the CGS demonstrated a 4-hour mean time between essential function failure compared to a requirement of 48 hours, and an availability of 0.62 compared to a requirement of 0.75. The High Mobility Trailer is unsafe and not usable. These unfavorable operational effectiveness and operational suitability evaluations caused the post-ponement of the full-rate production decision. In December 1998, twelve LRIP systems were approved to maintain the production line while additional testing was conducted. Again, in September 1999 seven LRIP systems were approved to maintain the production line while additional testing was conducted. In total, seventy-nine systems of a total buy of 96 CGSs have been approved to be built as LRIP systems.

TEST & EVALUATION ACTIVITY

In December 1999, the Air Force completed the operational test phase of the E-8C Block 10 upgrade testing. The Block 10 upgrade was not on oversight. This testing evaluated the operational effectiveness of the software changes that implement the Tactical Digital Information (TADIL-J) upgrade (TJU). The operational phase of testing consisted of transmitting and receiving data with an Airborne Warning and Control System (AWACS) E-3 aircraft during a JSTARS helicopter detection test. This test event did not include the E-8C performing its normal ground surveillance mission.

During the first half of FY00, the Air Force tested the Computer Replacement Program (CRP), the Block 20 upgrade to the E-8 aircraft. The focus of the testing was to demonstrate that the CRP did not degrade the performance of the E-8C or adversely impact its ability to conduct its operational missions. The testing was not intended to demonstrate the operational effectiveness and suitability of the Block 20 E-8C. The test was conducted as a combined DT/OT. The test included one sortie flown during the All-Service Combat Identification Evaluation Team (ASCIET) 2000 exercise and several sorties during the F-15E Fighter Data Link OT&E.

A Milestone II decision for RTIP was passed in January 2000. As part of this effort the Air Force produced a separate RTIP TEMP, which was approved by DOT&E on January 28, 2000. During CY00, the Air Force subsequently restructured the RTIP program as a Multi-Platform RTIP (MP-RTIP) program. MP-RTIP will design and develop modular, scalable radars that can be used on a variety of airborne platforms such as Global Hawk and the large-body Wide Area Surveillance platform as well as the NATO Transatlantic Advanced Radar project platform. Current plans call for integration work to be accomplished on Joint STARS aircraft (T-3) for airborne testing, however a U.S. Air Force airborne platform decision in FY02 could alter that approach. Regardless of platform choice, the Air Force will produce a separate TEMP for platform integration in conjunction with the Milestone II decision in FY03.

Two T&E events and operational field assessments of the CGS supported the full-rate production decision made in August 2000. These included the CGS IOT&E, an Operational Reliability Demonstration Test (ORDT) and evaluation of CGSs deployed in Korea, and a Limited User Test (LUT).

The CGS IOT&E was conducted at Ft. Huachuca, AZ from March 15-April 13, 1998. The test was scheduled to start in November 1997, but was delayed due to CGS computer software problems. Developmental testing of CGS in 1997, which preceded CGS IOT&E, was characterized by schedule slips and software problems.

Initial Operational Test and Evaluation consisted of two test phases: a live flight phase and a simulation phase. During the live flight phase, CGS operators used radar imagery from a JSTARS E-8C aircraft to respond to surveillance and targeting taskings. The taskings required CGS operators to detect, locate, track, and identify various ground targets throughout Southeastern Arizona. The taskings were representative of how CGS would operate in wartime, and were developed by experienced Army intelligence officers based on Army doctrine. The targets were representative of stationary and moving targets that JSTARS is expected to locate and track during actual operations. There were eight missions, each approximately 5 hours in duration, in which E-8C provided imagery to the CGSs.

During the simulation test phase, a JSTARS simulator was used to emulate radar information received from an E-8C aircraft, thus eliminating the need to fly the aircraft. The simulation provided JSTARS imagery of Southwest Asia. This test phase was conducted over 96 continuous hours.

A subsequent test, called the Operational Reliability Demonstration Test (ORDT), was conducted in February 1999 at the Motorola factory in Scottsdale, AZ. The purpose of the ORDT was to assess whether some of the specific failures identified during the CGS IOT&E had been corrected. However, the number and extent of the limitations (e.g., lack of an E-8C and realistic radar usage by CGS crews adequately trained to the latest tactics, techniques and procedures, use of incomplete one-way simulations for interfaces) impacted the realism necessary for an adequate test of suitability.

From February 7-17, and again from March 21-28, 2000, a team of DOT&E personnel observed the operations of CGSs deployed to U.S. and allied forces in Korea. The CGSs were supporting intelligence staffs at the Combined Analysis Control Center, Camp Humphreys; the 2nd Infantry Division

Analysis Control Element, Camp Red Cloud; the Deployable Intelligence Support Element with the Third Republic of Korea Army, Yong-in; and at a 6th Cavalry Brigade training exercise, Camp Humphreys. The CGSs received radar imagery during missions flown by a JSTARS E-8 aircraft and an Airborne Reconnaissance Low (ARL) aircraft. The operations observed in March 2000 were a part of the annual Winter Surge exercise.

The CGS Limited User Test (LUT) was conducted from February 24-March 9, 2000, in conjunction with the ASCIET 2000 exercise at Ft. Stewart, GA. The ASCIET exercise consisted of ten days of "battles" between blue and red forces made up from all four branches of the United States armed services. The exercise included land, sea, and air operations.

Three CGSs were tested during the ASCIET exercise. The CGSs received information from the JSTARS E-8, Hunter Unmanned Aerial Vehicle, Rivet Joint, Navy EP-3, and Guardrail Common Sensor via the Commander's Tactical Terminal. The blue forces also had several other sensors that did not provide feeds via the CGS.

A JSTARS E-8 aircraft flew during the ASCIET battles and provided radar data to the CGSs. A backup E-8 aircraft also flew during every mission because of aircraft problems experienced during the pilot test. The E-8 surveilled the area in which the blue ground force and the opposing red ground force fought the battles during the ASCIET exercise. This area was approximately 10 kilometers by 15 kilometers in size, which is significantly less than 1 percent of the ground area covered by JSTARS conducting wide area surveillance when supporting a corps. The red force consisted of 30 to 40 tanks, armored personnel carriers, and air defense units.

TEST & EVALUATION ASSESSMENT

In the JSTARS E-8 B-LRIP, DOT&E assessed the E-8C as operationally effective in operations other than war. The radar picture contains information on large-scale movements of ground targets over a corps-sized area of interest. The commanders provided with this feel they have a measure of situational awareness that they previously did not have without the JSTARS E-8C.

During the operational phase of Block 10 testing, interoperability problems were observed in exchanging information with AWACS aircraft—the only platform that participated in the test. The AWACS E-3 aircraft had not implemented the TADIL-J message sets to receive target tracks from the JSTARS E-8C aircraft. Thus, the operational phase of the Block 10 test was inadequate for evaluating interoperability. Block 10 testing did find that there were man-machine interface deficiencies, primarily in the areas of track maintenance and with tabular displays of information on the operator's monitors.

The CRP OT&E demonstrated that CRP did not degrade the performance of the E-8C or adversely affect its ability to perform its operational mission. Some of the CRP DT/OT sorties were conducted jointly with the F-15E Fighter Data Link OT&E. During these sorties, the E-8C demonstrated the ability to find targets in a benign environment and pass that target information via TADIL-J to F-15Es that then successfully engaged the targets. During ASCIET, the Block 20 E-8C performed its assigned mission on day five of the 10-day exercise as well as the Block 10 E-8Cs performed the other nine days of the exercise. Additionally, during ASCIET, both the Block 10 and Block 20 E-8Cs participated in the JTIDS network, exchanging data with other Army, Navy, and Air Force participants. The operational interoperability of TADIL-J, however, was not evaluated during ASCIET. That is, the ability to use the exchanged information for mission accomplishment was not assessed. Finally, the new processor in radar of the Block 20 upgrade was far more reliable and required less maintenance than the troublesome radar processor in the Block 10 E-8C. Consequently, the Block 20 E-8 had a higher effective time on station than the Block 10 aircraft.

The CGS was adequately tested to support the full-rate production decision. Testing and field operations show that the CGS provides a useful military capability and is effective for battle management and surveillance of large moving target sets (20 – 30 vehicles). When compared to the Critical Operational Issues and Criteria, Operational Requirements Document, and Cost and Operational Effectiveness Analysis, the CGS cannot be considered operationally effective in the accomplishment of target attack missions and surveillance of company-sized target sets (8 – 11 vehicles). The CGS is not operationally suitable for its more stressing intended missions because of reliability, training, and the inability to operate on the move.

The operational tests showed that the resolution of SAR imagery from the E-8C is inadequate for CGS operators to distinguish small tactical formations of vehicles from their background. This limits the ability of the CGS to support the surveillance and targeting of small tactical formations such as Scud missile units. Test results show that the CGS did not consistently and successfully target moving vehicles.

The CGS is not suitable for tactical employment because it is incapable of on the move operations without additional power from the 10-kilowatt generator in its trailer. Safety problems with its trailers have caused the Army to replace the intended two trailers with an additional HMMWV as an interim solution. Training of the operators, non-commissioned officers, crew, and staff is inadequate to fully exploit the capabilities of the CGS. The CGS exceeds its operational availability requirement of 0.75 with a demonstrated value of 0.83. The demonstrated mean time between system abort is 39 hours, which is less than its requirement of 48 hours.

For additional details on the CGS IOT&E, see the DOT&E B-LRIP report dated August 16, 2000.

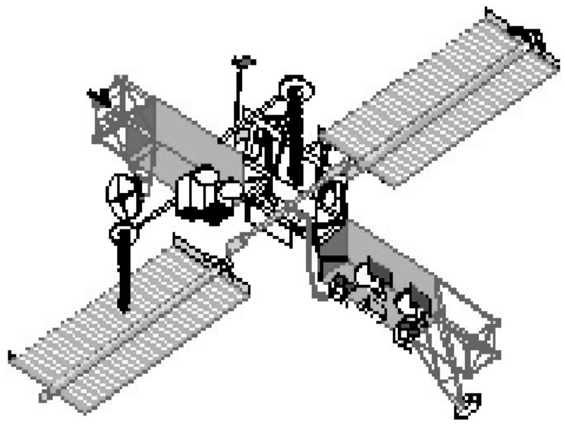
CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

The RTIP program that upgrades the radar on-board the JSTARS aircraft is a major defense acquisition program. The operational test program for RTIP will be defined during the coming years. The future test program must include full participation by the Army to involve CGS and Common Data Link. The Army needs to continue integrating the CGS into its intelligence and fire support process. We recommend that (1) the remote work station be fully upgraded to the same capability as the operator work stations inside the CGS shelter; (2) training shortfalls be corrected with a viable and constructive simulation to support and sustain training for operators, non-commissioned officers, crew and staff in addition to robust training events with an E-8C; and (3) the maintenance concept be reviewed with respect to improving the built-in test equipment and reliability.

Further, we recommend improvements be made to the CGS system and its tactics, techniques, procedures and training for the following areas: (1) the capability of the CGS to support Army staff with targeting missions including (a) the ability of the CGS to identify, track, and predict the arrival time of targets, and (b) pass that targeting information through the fire support command structure so that fire support units can engage and kill enemy targets, especially fleeting targets such as Scud missile units; (2) the capability to support surveillance and targeting missions against stationary targets; and (3) the capability to operate on the move.

When these shortfalls are corrected, FOT&E is required to assess the improvements made. Interoperability between the CGS and the Army's automated intelligence and targeting systems in the digital Army of the future should also be tested. FOT&E of the CGS, except for stationary targets, should not wait until the Air Force's operational test of the JSTARS upgrade program—RTIP. RTIP OT&E is not expected to take place for many years.

MILITARY STRATEGIC AND TACTICAL RELAY (MILSTAR) SATELLITE SYSTEM



Air Force ACAT ID Program

Total Number of Satellites:	6
Total Program Cost (TY$):	N/A
Average Unit Cost (TY$):	N/A
Full-rate production:	N/A

Prime Contractor

Lockheed Martin

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Military Strategic and Tactical Relay (MILSTAR) satellite system supports strategic and tactical missions through global communications that are secure, jam resistant, survivable, and have a low probability of intercept. MILSTAR's unique capabilities will enable our forces to maintain ***information superiority*** throughout all levels of conflict, enhancing ***full-dimensional protection*** and ensuring that warfighters retain freedom of action through continuous, secure communication.

Through the combined capabilities of a six-satellite constellation, MILSTAR provides support for worldwide coverage for multi-Service ground, airborne, submarine, and shipborne terminal communications connectivity and a mission control segment with constellation control stations proliferated worldwide for system survivability. The following paragraphs describe the three MILSTAR segments—space, terminal, and mission control:

- Space Segment: The full MILSTAR operational capability will be provided by four geosynchronous satellites. The first two satellites possess the original strategic communications Low Data Rate (LDR) payload (75-2400 bits/second), while the third and subsequent satellites will also possess a tactical Medium Data Rate (MDR) payload (to 1.544 mega-bits/second) in addition to the low rate payload. Each medium data rate satellite will use a variety of antennas to support the requirements of both tactical and strategic users. Additionally, cross-links between the satellites will provide worldwide connectivity without using vulnerable ground relays.

- Terminal Segment: The MILSTAR terminal segment consists of a family of multi-Service ground, shipborne, submarine, and airborne terminals functionally interoperable and tailored to meet individual Service requirements. These terminals consist of the Air Force air and ground command post terminals, the Navy Extremely High Frequency Satellite Program (NESP) ship/shore/submarine terminals, and the Army's Single-Channel Anti-jam Man-Portable (SCAMP) terminal and Secure, Mobile, Anti-jam, Reliable, Tactical Terminal (SMART-T). SMART-T is the first medium data rate capable terminal. The Navy's NESP terminals are also being upgraded to be medium data rate capable.

- Mission Control Segment: The MILSTAR mission control segment provides communications resource management and satellite operations support. The primary responsibility of the mission control segment is to maintain the satellite in a state of readiness to support user communication requirements during all levels of conflict.

BACKGROUND INFORMATION

The first MILSTAR satellite was launched in 1994 onboard a Titan IV rocket. The second satellite was launched in 1996. MILSTAR Flight 3, the first medium data rate satellite, was launched on April 30, 1999. However, the mission was declared a failure when a problem with the Centaur upper stage placed the satellite in an operationally useless orbit. Post-launch data indicate the Flight 3 satellite would have been able to withstand the normal launch and on-orbit environments. In lieu of an additional MILSTAR satellite to replace Flight 3, the first flight of the Advanced EHF satellite program (Pathfinder) will be launched on an accelerated schedule and programmed to operate initially as a MILSTAR II satellite. MILSTAR Flight 4 is currently projected for launch in 2QFY01.

Air Force Space Command declared MILSTAR's IOC-1 on July 21, 1997. The MILSTAR low data rate system currently supports IOC-1 missions.

TEST & EVALUATION ACTIVITY

Low data rate IOT&E was conducted in two phases. Phase I IOT&E (completed September 1995) addressed system connectivity and interoperability, while Phase II (completed March 1997) addressed system control, cross-link communications, and incomplete test events from Phase I testing. AFOTEC concluded this phase with the second Dedicated Asset Test, addressing communications connectivity over networks using cross-links between Flight 1 and Flight 2 MILSTAR satellites, as well as issues not resolved in Phase I low data rate IOT&E.

The Navy completed operational field tests of their terminals' vulnerability to downlink jamming in 1996. AFOTEC based their evaluation of uplink anti-jam performance of the Air Force and Navy terminals on the results of the Air Force Information Warfare Center's jamming vulnerability model. The Army completed developmental factory tests of their terminals' vulnerability to downlink jamming in 1998. AFOTEC plans to evaluate the jamming vulnerability of the Army terminals during the planned medium data rate IOT&E in 2QFY01 (after the launch of MILSTAR Flight 4).

The Milstar IOT&E Final Report (August 1988) stated that the Milstar LDR system was effective and suitable with limitations. DOT&E and AFSPC directed AFOTEC to re-test six Measures Of Performance (MOP). AFOTEC re-tested three connectivity MOPs during the September 1999-

February 2000 period. The three MOPs, all of which achieved a "Met Requirements" rating were: (1) Ultra High Frequency operations; (2) Teletype message quality; and (3) Joint Chiefs of Staff (JCS) Teletype Emergency Action Message (EAM).

The updated MILSTAR II (medium data rate) TEMP is currently undergoing formal Service coordination prior to DOT&E approval. The MDR tests will focus on individual and combined Service terminal tests communicating through an in-orbit satellite. Several developmental and operational test events addressing the performance of the MILSTAR II System have been delayed by the launch failure of the Flight 3 satellite. Operational testing with the Flight 4 medium data rate satellite is being planned in expectation of a 2QFY01 launch.

TEST & EVALUATION ASSESSMENT

MILSTAR low data rate IOT&E addressed four COIs: (1) system connectivity; (2) control; (3) survivability; and (4) suitability. DOT&E found performance limitations associated with each COI described below. Since these limitations have the potential to seriously degrade the warfighting capability of the MILSTAR low data rate system, each must be addressed by the development and user communities as expeditiously as possible. It is worth noting that none of the limitations are related to satellite performance.

Connectivity addresses the ability of the MILSTAR system to provide secure, worldwide, interoperable communications at all levels of conflict. One key parameter relating to strategic bomber in-flight command and response is unresolved pending operational test of an Air Force terminal software upgrade. The threshold parameters for Voice Quality, Teletype Quality, and JCS Emergency Action Message receipt fell slightly below performance requirements. However, the observed shortfalls have not been shown to significantly limit mission capability. Additionally, voice conferencing to support Joint Staff MILSTAR networks was found to be ineffective. Some improvements to the voice conferencing networks have been made and will undergo further Joint Staff and AFOTEC testing.

Control addresses the ability of MILSTAR to provide adequate satellite constellation planning and management and control to maintain/re-allocate user communications through all levels of conflict. There are four System Control Elements. The *Mission Control Element* and *Mission Support Element* were tested and evaluated during low data rate IOT&E. The *Mission Planning Element* and *Mission Development Element* were still in development and not tested. Tests showed a lack of established operating procedures to initiate MILSTAR autonomous wartime operating mode. Additionally, mobile constellation control stations lacked the requisite problem resolution capabilities to support the constellation during some satellite emergency conditions. Further, the endurance test revealed an endurance shortfall. Since the endurance test period lasted for less than the required duration, DOT&E directed a full re-test of the endurance requirement during follow-on testing. AFOTEC is engaged in discussions with Air Force Space Command and Strategic Command to determine the most appropriate Joint exercise to conduct this test. The test will evaluate the effectiveness of the corrective actions made to the other control issues found in IOT&E. Further discussions of control may be found in the classified version of the MILSTAR Annual Report.

Survivability addresses MILSTAR's ability to provide the minimum essential wartime communications through all levels of conflict and the post-attack period. DOT&E has determined that system anti-jam performance for low data rate communications is satisfactory. Further discussion of survivability may be found in the classified version of the MILSTAR Annual Report.

MILSTAR LDR also met the requirements for low probability of signal detection and interception. Although the submarine terminal met low-probability of intercept requirements, operational tests of the terminal under realistic conditions indicated that the terminal was more vulnerable to detection than previously found in development tests. This experience is being applied to MILSTAR medium data rate system tests, particularly in the area of terminal antenna performance.

Suitability addresses MILSTAR's RAM to sustain operations in a wartime environment. Discussion of suitability may be found in the classified version of the MILSTAR Annual Report.

The MILSTAR Space, Terminal, and Control Segments have all been certified Y2K compliant. The Air Force Program Executive Officer for Space certified Space Segment compliance on the Control Segment on September 30, 1998. The separate terminal programs have been certified Y2K compliant by their respective Service agencies.

AFOTEC conducted a three-phase connectivity re-test from September 1999-February 2000. They observed a 99.1 percent success rate for report back requirement on four simultaneous Demand Activated Multiple Access channels and a 90.1 percent success rate for the Dual Modem Upgrade terminal log-on criteria. The system also demonstrated a 98.9 percent success rate for Teletype message quality, and exceeded threshold specifications for delivery of intelligible and usable EAMs. At the same time, AFOTEC observed several areas for improved operations, particularly with respect to training and procedures, which are described in the test report.

CONCLUSIONS

The MILSTAR Space Segment continues to perform well as currently fielded with LDR capability. As there has been no operational testing with an on-orbit medium data rate satellite, no firm conclusions can be made regarding medium data rate performance. However, review of the developmental test program for the space segment has not revealed any areas of operational concern.

The MILSTAR Terminal Segment has met with mixed results. The Navy's low data rate terminals have been fielded for four years with much success. The Air Force airborne and Army ground terminals have all demonstrated reliability and maintainability shortfalls. Further discussion of the Navy NESP and Army SCAMP and SMART-T terminals are provided in separate Annual Reports.

The Mission Control Segment for low data rate operations has been performing its peacetime mission successfully since the launch of the first MILSTAR satellite in 1994. The transportable control terminals have demonstrated the ability to control the constellation, although there are some issues in the areas of reliability and maintainability, which are discussed in the classified Annual Report. Medium data rate operations have not been operationally tested. However, delays in the development of the automated communications management system to support tactical operations are of concern. Further discussion of this issue can be found in the SMART-T Annual Report.

The Space, Terminal, and Mission Control Segments of the MILSTAR system are not maturing at the same rate. The Navy low data rate terminals have been fielded for four years, while operational tests have shown that the Army terminals are not ready for fielding. Communications planning and management systems required to effectively plan, control, and re-configure networks during wartime remain behind schedule. These disparities create numerous challenges in evaluating the operational effectiveness and suitability of various MILSTAR segments, and in evaluating the MILSTAR system as a whole.

While operational testing has shown that MILSTAR supports effective low data rate communications in a peacetime environment, several deficiencies were found that affect its strategic wartime capability. Of additional concern until the launch of Pathfinder in FY05—worldwide coverage from 65 North to 65 South will not be available for the MILSTAR medium data rate terminals. The lack of a fourth medium data rate satellite will limit the ability to provide two-satellite coverage to contingency operations and therefore limit the throughput of protected communications.

RECOMMENDATIONS

The Air Force, Army, and Navy operational test agencies are finalizing their individual and joint Service test plans for low and medium data rate operations. DOT&E has reviewed the preliminary test documentation, concurs with the overall strategies and emerging details, and is encouraged by the degree of cooperation among the agencies. However, resources must be scheduled and plans finalized immediately to carry out the tests as planned. To this end, DOT&E recommends that the Milestone III TEMP and ORD be finalized and approved as soon as possible.

MINUTEMAN III GUIDANCE AND PROPULSION REPLACEMENT PROGRAMS (GRP)

Air Force ACAT IC Program		**Prime Contractor**
Total Number of Systems:	500 missiles deployed	ICBM Prime Integrating Contractor (TRW)
Guidance Replacement Program (GRP):	652 guidance units replaced	
GRP Program Costs (TY$):	$1.889B	
GRP Unit Costs (TY$):	$2.9M	
GRP Production:	December 1999	
Propulsion Replacement Program (PRP):	607 boosters remanufactured	
PRP Program Costs (TY$):	$2.589B	
PRP Unit Costs (TY$):	$4.3M	
PRP Production:	2QFY01	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

Minuteman III is an Intercontinental Ballistic missile (ICBM) deployed in hardened silos. Five hundred Minuteman III ICBMs and 50 Peacekeeper ICBMs together form one leg of the Strategic Triad of bombers, submarine-launched ballistic missiles, and ICBMs that provide strategic nuclear deterrence for the United States. Operational basing support for Minuteman III includes missile alert facilities, hardened launch facilities, and underground launch control centers. Minuteman III bases are currently located at Francis E. Warren AFB, WY; Minot AFB, ND; and Malmstrom AFB, MT.

The ***Guidance Replacement Program (GRP)*** is a set of hardware and software modifications designed to extend the service life of the Minuteman III while preserving its current capabilities. This program is needed to prevent a projected decline in reliability due to aging electronic components and unavailable replacement parts. GRP replaces the guidance computer, signal converters, and power distribution components while retaining the current Minuteman III Inertial Measurement Unit (IMU). Affordability considerations precluded IMU replacement, which would have permitted improvements in accuracy and more significant improvements in reliability and availability. GRP is required to preserve current accuracy and reliability while enhancing supportability. Since the threshold requirement for the GRP was to maintain current Minuteman III capabilities, the Operational Requirements Document (ORD) and evaluation criteria for the GRP were derived from the performance and specification of the presently fielded Minuteman III guidance system (designated the NS-20). GRP reached Milestone III in December 1999, and is currently in full-rate production. The program achieved Initial Operational Capability, defined as having ten GRP-modified guidance systems (designated the NS-50) with an excess of 720 hours of operation plus four spares on July 20, 2000.

The ***Propulsion Replacement Program (PRP)*** will extend the life of the MM III operational force by replacing the solid propellant propulsion sub-systems. The solid propulsion systems now in the force are projected to begin aging out in 2002 and must be replaced in order to support current force planning. PRP is being executed in two phases, Technology Insertion (TI) and Remanufacture. During the TI phase, new materials and manufacturing processes were qualified to replace unavailable or environmentally prohibited materials (e.g., ozone depleting chemicals). During remanufacture, the solid rocket motors and inter-stage hardware and ordnance are being recycled from the force and remanufactured at a rate of up to eight motors per month during the FY00-FY08 period. PRP is currently in LRIP. PRP is required to preserve current Minuteman III effectiveness and suitability characteristics.

As ***Joint Vision 2020*** looks to the future of America's armed forces, it also provides a vision for America's continuing strategic requirement. As an important component of the Strategic Triad, Minuteman III directly contributes to ***precision engagement*** with its flexibility to re-target its weapons when required.

BACKGROUND INFORMATION

The DOT&E approved TEMP and Test Plan for GRP incorporated a test concept that combined a series of developmental and operational tests and culminated in two operational test flights in 1998. The TEMP acknowledged that a data base of two flights was insufficient for confident estimates of accuracy and reliability. The test methodology relied upon extensive Hardware-In-The-Loop simulations and engineering estimates to help mitigate the risks that attend this small sample size. It was understood that observations taken from follow-on operational test flights with the modified guidance system and the two Propulsion Replacement Program flights, which require the modified guidance system, would expand these data bases. GRP test and evaluation ran from 1994-1999, and comprised 17 discreet test and evaluation events. DOT&E staff and support personnel observed ground and flight tests throughout the test program.

DOT&E prepared a B-LRIP report for the Guidance Replacement Program in December 1999. Based on the information collected and analyzed during IOT&E, and the combined developmental and operational test activities preceding it, DOT&E determined the GRP upgrades to be operationally effective and suitable. However, in the B-LRIP report, DOT&E indicated that there had been insufficient numbers of flights to confirm accuracy and reliability assessments. Specifically, the GRP program's two flight tests and the PRP program's two subsequent flight tests, all four using the NS-50 guidance system, had not decisively demonstrated that the GRP-equipped MM III met the accuracy threshold listed in the ORD. GRP proceeded to full-rate production in December 1999. Although GRP testing was adequate to support the Milestone III decision in December 1999, DOT&E requested that additional test data from the PRP flight tests and the Air Force Space Command-conducted Force Development Evaluation flight test program continue to be collected and analyzed to strengthen evaluations of accuracy, availability, mean time between maintenance, and service life.

TEST & EVALUATION ACTIVITY

All programmed Operational Test events have been completed for the Guidance and Propulsion Replacement Programs. AFOTEC conducted Early Operational Assessments and IOT&E on both replacement programs, and also collected extensive information during Hardware-In-The-Loop developmental testing. The results of both Early Operational Assessments were satisfactory. AFOTEC determined in its April 1999 final IOT&E report that GRP was operationally effective and suitable. AFOTEC began dedicated IOT&E in January 2000 for the Propulsion Replacement Program. The second demonstration flight test of May 24, 2000 was the last dedicated IOT&E event, but AFOTEC continued to monitor static firings into September 2000. AFOTEC is currently preparing its final IOT&E report for PRP.

Considerable Propulsion Replacement Program test activity continued throughout FY00, culminating in two capability demonstration launches on November 13, 1999 and May 24, 2000. Although the propulsion objectives of the capability demonstration launches were achieved, both launches experienced anomalies. The final evaluation report for the first Flight Test (FTM-1) revealed a higher than predicted use of injectant by the Stage 3 Liquid Injectant Thrust Vector Control system during the flight. While FTM-1 completed the test mission, the program determined that the high injectant usage rate was caused by the misalignment of the Stage 3 nozzle due to a flaw in the alignment process. The necessary corrections to the alignment process delayed the second flight test from February-May 2000. The re-entry vehicle miss distances were considerably larger than the requirement specified in the ORD. FTM-2 was launched on May 24, 2000, but it terminated pre-maturely when stage separation did not occur. An Air Force investigation found that the anomaly occurred in the Stage 3/Propulsion System Rocket Engine (PSRE) separation event. The arm/disarm switch for the ordnance that separates Stage 3 from the PSRE was at fault. The Air Force report concluded that the anomaly was an isolated problem that was not related to the PRP, GRP, or PSRE programs. Unfortunately, this fourth flight test using the GRP-modified NS-50 guidance system did not provide any accuracy data.

On September 28, 2000, Air Force Space Command launched two Minuteman III ICBMs configured with the GRP-modified NS-50 guidance system, each carrying two instrumented test re-entry vehicles from Vandenberg AFB to the Kwajalein Missile Range. The short-time interval launches occurred within two hours of each other. The four instrumented test re-entry vehicles were scored, but the quick-look impact data again did not decisively demonstrate that the accuracy key performance parameter had been achieved. Two more flight tests are scheduled in February and June 2001.

TEST & EVALUATION ASSESSMENT

DOT&E's conclusions concerning the accuracy of the Minuteman III guidance replacement package have not changed since issuing the GRP BLRIP report. When the report was written, the Air Force had conducted three flight tests with the new guidance system. As noted previously, a fourth accuracy data point did not subsequently materialize due to the premature termination of the FTM-2 flight test. Flight test data available to date are insufficient for a determination as to whether Minuteman III accuracy requirements are being met. Accuracy is a key performance parameter in both the GRP and PRP ORDs.

Early test planning recognized the limitation of conducting only two flight tests for GRP and two more flight tests for PRP. Since flight test assets are taken from a finite number of available spares that must sustain the operational force through 2020, the Air Force made a strong case that the "Engineering Estimates" accuracy model, validated with years of accumulated data from flight testing using the pre-GRP NS-20 guidance system, was the most cost-effective means to evaluate the GRP-modified NS-50 guidance system. This approach balanced the sustainment and test needs of the operational force against the need to test the GRP and PRP modifications. Since the NS-50 was designed as an electronic component replacement program and not a totally new design guidance system, the Engineering Estimates model was adjusted for the parameters affected by the GRP modifications, and the test community accepted the model as a valid way to evaluate the accuracy of the modified NS-50 guidance system. AFOTEC used the Engineering Estimates model and analyzed actual flight test data relative to the model's prediction to evaluate the issue of operational effectiveness. The Air Force maintains that NS-50 performance falls within the family of NS-20 demonstrated results over the history of the Minuteman III program. Based on the NS-50 flight tests to date, DOT&E is not convinced that the NS-50 results belong to the NS-20 family of results. Additional flight testing is required.

Due to inconclusive accuracy results of the first four NS-50 flights, DOT&E now requires four additional NS-50 flight tests to support the PRP B-LRIP report. The PRP TEMP is being modified to reflect the additional flights, which will use already scheduled Force Development Evaluation (i.e., follow-on operational) flight tests of Minuteman III ICBMs configured with the NS-50 guidance system. As noted earlier, two of the four additional flight tests were conducted on September 28, 2000, but accuracy data has not yet been available for DOT&E analysis. DOT&E will prepare a PRP B-LRIP report after results of additional flight testing are available. In the interim, the PRP has entered a second year of LRIP.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

The Guidance and Propulsion Replacement Programs came under OSD oversight well after the initial TEMPs had been developed. DOT&E accepted the test methodology and approach after-the-fact, including reliance on the Engineering Estimates accuracy model and only four capability demonstration flight tests. However, the four capability demonstration flight tests were not enough to decisively demonstrate that the accuracy key performance parameter in the GRP and PRP ORDs had been achieved. The Engineering Estimates accuracy model predicts a slight improvement in accuracy compared with the Operational Requirements Document threshold, and both programs assumed success. DOT&E would be reluctant to approve such limited flight test planning in the future.

NATIONAL AIRSPACE SYSTEM (NAS)

Air Force ACAT IC Program

Total Number of Systems:	106 DAAS	
	96 DASR	
	222 VCSS	
	1 MAMS	
Total Program Cost (TY$):	$1021M	
Average Unit Cost (TY$):	$11M	
Full-rate production:	2QFY01	

Prime Contractor

Raytheon (Radar/Automation)
Litton Denro (Voice Switches)
Raytheon (Airspace Scheduling)

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The National Airspace System (NAS) program will replace three types of Air Traffic Control and Landing System (ATCALS) equipment used to support Air Traffic Control's radar approach control mission. NAS includes voice switches, approach control and control tower automation, and airport surveillance radars. The NAS program modernizes radar, voice networks, and automation functions within the air traffic control and landing systems at 92 DoD sites. The NAS program also includes the Military Airspace Management System (MAMS), an off-line, one-of-a-kind web site-based special use airspace scheduling and utilization tracking system accessed via the Internet.

NAS modernization will enhance ***precision engagement*** through ***technological innovations*** that will allow DoD to keep pace with state-of-the-art digital radar approach control equipment and improve scheduling of special use airspace to ensure wartime readiness. NAS modernization supports the ***Joint Vision 2020*** mandate of ***interoperability***, especially in terms of communications and information sharing with the Federal Aviation Administration (FAA). ***Information superiority*** will be realized when DoD and FAA users have the necessary information capabilities to achieve their operational objectives.

BACKGROUND INFORMATION

The ATCALS equipment to be replaced has limited interoperability and excessive cost growth for operations and support. The FAA has undertaken a massive upgrade of the nation's air traffic control system infrastructure by replacing analog systems with state-of-the-art digital technology. Most DoD systems are currently analog and will not easily or economically interface with the new-generation FAA equipment. Without the added capability, DoD will be unable to continue providing efficient and reliable service to all air traffic system users, military or civilian. Furthermore, DoD NAS cost and operational effectiveness analyses indicate that DoD will experience excessive operations and support costs if the DoD air traffic control equipment is not replaced. When fully fielded, the DoD NAS program upgrade will include the following four programs:

- Voice Communications Switching System (VCSS) performs all control functions needed for air traffic control communications, including radio, intercom, and telephone access. VCSS provides an interface to analog switch and distribution systems and interfaces with legal voice recorders.

- DoD Advanced Automation System (DAAS) will receive and process primary and secondary radar data, flight plan information, weather, airport environmental data, and administrative information (such as Notices to Airmen) required for operation of the local air traffic control facility.

- Digital Airport Surveillance Radar (DASR) consists of integrated primary and secondary radar sub-systems and will provide highly accurate target data to the local air traffic control facilities. The DASR's digital data output is compatible with the FAA's radar network and the DAAS. The DASR will have improved target detection and accuracy, clutter rejection, aircraft identification accuracy, altitude data, and weather capability.

- Military Airspace Management System (MAMS) will provide the ability to efficiently schedule, track, and document utilization of special use airspace in a non real-time manner, as well as interoperate with the FAA. Scheduling agencies will access the MAMS central web site using their existing desktop computers with Internet access. MAMS is not used as a real-time scheduling or airspace control tool; there are no safety of flight issues associated with MAMS.

The FAA is the lead organization for VCSS and DAAS testing, with the Air Force serving as DoD lead for DASR testing and sole test agency for MAMS. DoD is working with the FAA through an interagency agreement for all VCSS, DAAS, and DASR test activities.

VCSS DoD Multi-Service Operational Testing and Evaluation (MOT&E) occurred throughout 1999. The VCSS was found to be operationally effective; however, VCSS was rated not operationally suitable because of interrelated parts reliability, maintainability, depot-level support, spares provisioning, and technical documentation issues. DOT&E reviewed corrective actions taken after MOT&E and found those actions adequate to rectify the suitability shortcomings. The corrective actions, along with the high level of operational availability, inherent redundancy in the system, and demonstrated ability of the radar approach control and control tower to perform their operational missions, led DOT&E to the conclusion that VCSS was operationally suitable. The full-rate production decision was executed in November 1999.

TEST & EVALUATION ACTIVITY

The MAMS test readiness review for acceptance testing was held in February 2000. Windows NT Service Pack 6a was successfully loaded and tested by Raytheon as part of their engineering tests. Acceptance testing of MAMS began later in February 2000. The contract modification to extend the current period of performance through the end of September 2000 was completed in February 2000.

DAAS and DASR developmental testing and evaluation were completed in early October 1999. One Category 1 deficiency was found for DAAS and no Category 1 deficiencies were found for DASR. Based on favorable developmental test findings, both DAAS and DASR proceeded to combined developmental and operational testing.

DAAS and DASR underwent combined developmental and operational testing from October 1999-January 2000 at Eglin AFB to examine system specifications and compliance with user-validated requirements in the Operational Requirements Document. Dedicated flight checks were flown and analyzed to ensure that detection, coverage, accuracy, and resolution requirements were objectively quantified. As the lead tester for DoD, AFOTEC published findings for the testing in separate operational assessment reports. Based on demonstrated DAAS functionality, the DAAS report supported an LRIP decision in January 2000. An LRIP quantity of up to 20 DAAS systems was approved by the Air Force. After follow-up verification of fixes to DASR deficiencies, an LRIP quantity of up to 20 DASR systems was approved by the Air Force in February 2000. FAA purchases of identical equipment are made through the agency’s own procurement channels, although on the same contract award.

The DAAS and DASR operational assessment reports documented additional deficiencies, some of which needed to be resolved before the start of MOT&E and others that needed to be resolved before full fielding of the systems. DAAS deficiencies concerned training, record and playback functionality, system flight plan capabilities, aircraft handoff processing, false targets, false weather, security vulnerabilities, and system adaption and certification issues. DASR deficiencies included sub-clutter visibility, weather processing, radar coverage and probability of detection, false tracks and plots, azimuth accuracy and resolution, logistics support, training, and spares. The program office embarked on a plan to address the DAAS and DASR documented deficiencies. The DAAS and the DASR began regression testing in April 2000 at Eglin AFB. In June 2000, all deficiencies critical to multi-Service operational testing were either verified as fixed or downgraded in their severity. The Air Force deemed DAAS and DASR ready to proceed to MOT&E.

DAAS and DASR began parallel multi-Service operational testing at Eglin AFB in June 2000. Joint testing of both systems was required because the majority of existing analog equipment will not interface with the newer digital hardware. AFOTEC is conducting the task-based evaluation of DAAS and DASR, and will determine the DAAS and DASR mission-level utility. Additionally, requirements that were not fully assessed during the combined developmental and operational test period are being re-examined. The results of the MOT&E will support the NAS Milestone III decision, focusing on full-rate production of DAAS and DASR.

DOT&E most recently visited Eglin AFB during DAAS and DASR MOT&E in September. A number of outstanding system issues precluded the successful completion of MOT&E. For example, controllers reported that an excessive amount of false primary plots were being displayed from the DASR during Emergency Service Level operations on all terminal controller workstations. Controllers stated the problem was worse when heavy clouds or rain were in the radar area. The Eglin controllers decommissioned the DAAS Emergency Service Level operation in September.

As a result of documented DAAS and DASR deficiencies, on October 3 AFOTEC agreed to stop DAAS/DASR MOT&E to allow the Air Force to make changes in the software that drives the digital radar and automation systems. The Air Force believes the time out is the best option for the NAS program and protects the ability of the Air Force to ensure the DAAS and DASR are effective and suitable when ultimately fielded. A total of 15 Category 1 deficiencies were reported, six associated with the DAAS and nine associated with the DASR. The Eglin controllers believe the DAAS and DASR are safe for operational use and will continue using them during the MOT&E temporary halt. Representatives from the NAS Program Office and AFOTEC will be working out the details of the test delay and a plan of action. DOT&E is committed to staying actively engaged in the process.

TEST & EVALUATION ASSESSMENT

DOT&E and AFOTEC share concerns with the planning considerations for the approach chosen for the MOT&E temporary halt. The NAS Program Office and AFOTEC needs to track closely Raytheon's development of fixes to deficiencies to ensure the rigor normally associated with developmental testing incorporated in the process. AFOTEC is developing re-entry criteria for the MOT&E. All Category 1 safety of flight deficiencies, and user-defined mission critical 2 deficiencies must be demonstrated as fixed before MOT&E resumes.

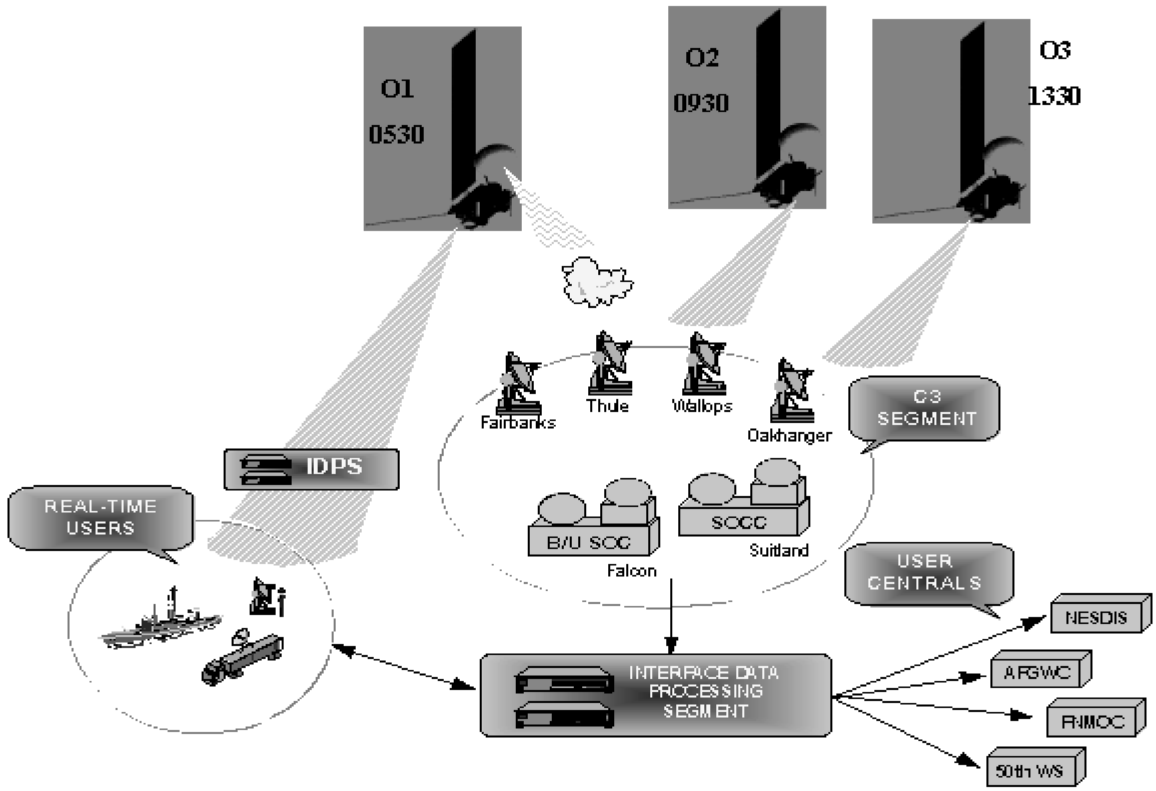
The oversight community will work with AFOTEC, the NAS Program Office, and users, to determine the rules of engagement for the test time out. It is tentatively planned that a member of the test team will remain on site at Eglin AFB for the duration of the developmental test period to observe fixes. AFOTEC will request a configuration audit prior to turning the DAAS and DASR over to the NAS Program Office and Raytheon for fixes and prior to receiving the systems back for continued MOT&E. AFOTEC has also suggested a notional 30-day period, following the implementation of system fixes and before MOT&E resumes, to allow the users time to develop confidence in the improved DAAS and DASR systems. The scope of involvement from the developmental testers has yet to be determined, along with many of the details of the action plan.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

It is acknowledged that the FAA's operational testing programs differ in scope and format from that of DoD's. Recognizing that, the OSD test community must continue to ensure robust independent testing of DoD-unique requirements while using the FAA test data as appropriate.

The key for continued success of the NAS program is for all agencies to continue good communications and to keep pace with the changing DAAS and DASR issues. Through consistent involvement with the NAS program, DOT&E has provided measurable contributed to shaping the entire NAS test process. DOT&E will remain fully engaged in the test process at this time, during the temporary halt to the DAAS and DASR MOT&E, and as the plan of action is being developed.

NATIONAL POLAR-ORBITING OPERATIONAL ENVIRONMENTAL SATELLITE SYSTEM (NPOESS)



Air Force ACAT ID Program		**Prime Contractor**
Total Number of Systems:	5 satellites	TBD
Total Program Cost (TY$):	$4.9B	
Average Unit Cost (TY$):	$985M	
MS II/III:	2QFY02	
First Launch:	2008	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The National Polar-Orbiting Operational Environmental Satellite System (NPOESS) is a Tri-Agency program jointly administered by DoD, the Department of Commerce's National Oceanic and Atmospheric Administration (NOAA) and the National Aeronautics and Space Administration (NASA). The program is managed by an NPOESS Executive Committee through an Integrated Program Office, and is being acquired under U.S. Air Force acquisition authority. NPOESS will provide a national remote sensing capability to acquire and disseminate global and regional environmental data for a period of at least ten years after achieving initial operational capability.

For military users, NPOESS will provide an enduring capability to receive and disseminate global and regional meteorological, environmental, and associated data at varying update rates depending on military needs. These data will include, but are not limited to, cloud imagery, atmospheric temperature and moisture, and solar-geophysical data to support worldwide military operations. NPOESS will provide the warfighter with the ***information superiority*** needed to execute the ***dominant maneuver*** operational concept. NPOESS also supports ***precision engagement,*** enhancing our forces' ability to plan and execute air, land, and sea operations throughout a large spectrum of challenging environmental conditions and within the enemy's decision cycle.

NPOESS contains the following segments:

- The Space segment, comprised of satellite platforms containing sensors and communications devices, will collect, store, and downlink data to the command, control, and communications C^3 segment and users on the ground. The satellites will selectively download all data to ground stations as well as provide continuous downlink of data for receipt by worldwide deployed DoD field units.
- The Launch Support segment is comprised of launch facilities and support equipment. NPOESS is expected to operate in a sun-synchronous, near-polar orbit at approximately 833 km in altitude.
- The C^3 segment includes all functions required for day-to-day state-of-health monitoring of all operating spacecraft, and supports the delivery of data to the designated primary terminals known as "Centrals."
- The Interface Data Processor (IDP) segment is comprised of data processing functions for two sub-components: the Centrals and the Field Terminals. Stored data will be delivered to the Centrals' Interface Data Processor component via the C^3 segment. In addition, the spacecraft will provide real-time data directly to line of sight military Field Terminal components and surface receivers operated by worldwide weather services and other agencies.

BACKGROUND INFORMATION

The U.S. government currently operates and maintains two polar-orbiting meteorological satellite systems. The USAF operates the military's Defense Meteorological Satellite Program system, while NOAA operates the Polar-orbiting Operational Environmental Satellite (POES) system. To reduce the costs of acquiring and operating polar-orbiting satellites, the White House announced a decision to integrate the two weather satellite programs into a single converged system in May 1994.

NPOESS Milestone I occurred in FY97. The Program Definition/Risk-Reduction (PDRR) phase was structured around system architecture studies, sensor and algorithm development, and Pre-Total System Performance Responsibility (TSPR) contracts. During PDRR, multiple contracts were awarded for each higher risk sensor and/or suite of sensors. A single contractor for each payload is being selected after each sensor/suite Preliminary Design Review and Call for Improvement. A competitive Pre-TSPR award to two contractors occurred in FY00 (to TRW and Lockheed Martin) to address data processing risks and bring the program to a System Functional Review level of development prior to TSPR selection. Selection of the final TSPR contractor will occur shortly after Milestone II in FY02.

Planned European participation in NPOESS has been reduced. NPOESS had planned to fly a sub-set of its sensor packages on the European Meteorological Satellite Organization (EUMETSAT) Meteorological Operational Program-3 (METOP-3) satellite, which would have met NPOESS coverage and data refresh rate requirements at relatively low cost. EUMETSAT's decision to bulk buy METOP satellites 1 through 3 precludes sensor package incorporation. The Program Office has proposed a solution of acquiring and orbiting a third NPOESS satellite containing two critical NPOESS sensors in place of METOP-3 in order to meet DoD imagery refresh rate requirements. Availability of this third NPOESS satellite would be two years later than the previously planned METOP-3; the Program Office has also proposed re-phasing the DMSP launches to cover the METOP-3 gap until the third NPOESS orbit is available. This solution meets all user Key Performance Parameters at an additional net life cycle cost of $60 million.

TEST & EVALUATION AND RISK-REDUCTION ACTIVITY

T&E and risk-reduction activities in FY00 included a TEMP revision, Preliminary Design Review (PDR) on a critical NPOESS sensor suite, drafting of a Combined Test Force charter, and refinement of the OT concept.

The initial TEMP was approved in March 1997. During FY00, the TEMP was revised to reflect the program's 1999 re-baseline, which delayed delivery of the first satellite by one year to July 2008. The re-baseline also delayed and modified the pre-TSPR risk-reduction activities and delayed the EMD contract award date to FY02. The revised TEMP also addresses the T&E management structure through a Combined Test Force (CTF), updates and refines the test concept and test activities, and specifies required T&E assets and funding.

The NPOESS test concept includes T&E risk-reduction during PDRR, which consists of sensor design and algorithm testing utilizing a government developed and operated Integrated Weather Product Test Bed. This ensures that each selected sensor contractor has provided a design/algorithm combination that meets NPOESS technical requirements, and is responsive to user's operational requirements.

The OT concept includes an Operational Assessments (OA), combined DT and OT (DT/OT), and an end-to-end IOT&E of the military portions of the NPOESS system. Three OA's are planned: OA1 in FY01-02 in support of MSII; OA2 in FY04 in support of Critical Design Review; and OA3 in FY06 in support of fielding of the C^3/IDP (Spell Out) segments. The OA's will be followed by a dedicated IOT&E in FY09 to support initial operational capability. To support early assessments, operational testing will augment field data with results from validated models, simulations, and hardware-in-the-loop test beds. Throughout the program, combined DT/OT will be used when appropriate to minimize the time required for dedicated IOT&E and to reduce the design risk by providing an operational perspective as early as possible in the acquisition process. During dedicated IOT&E, the operational testers will conduct testing on production-representative hardware and software, supplemented as required with data from validated and accredited modeling and simulation.

During EMD, a key risk-reduction activity is the NPOESS Preparatory Project (NPP). The NPP is a joint Integrated Program Office/NASA space flight of selected critical imager and sounding systems. This flight, scheduled for FY05, will provide NPOESS with a risk-reduction demonstration, and NASA with selected sensor data to provide continuity with current environmental and weather satellites. NPP activities will also include development of a ground C^3/IDP segment with legacy to the operational system.

During FY00, as part of risk-reduction, a PDR was held on the Visible/IR Imager Radiometer Suite (VIIRS), one of five critical NPOESS sensor suites. Previous PDRs had been held on three other critical NPOESS sensor suites: (1) the Global Positioning System Occultation Sensor (GPSOS) in November 1998; (2) the Ozone/Mapper Profiler Suite (OMPS) in January 1999; and (3) the Cross-Track

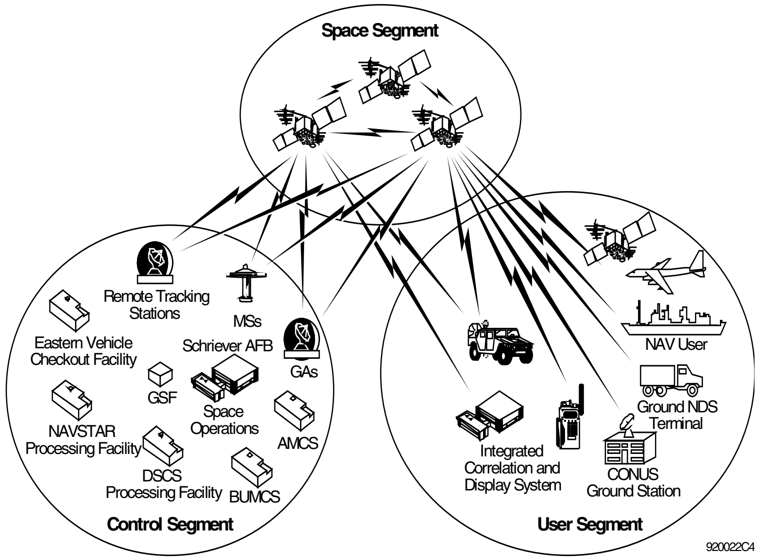
IR Sounder (CrIS) in April 1999. The remaining critical sensor suite, the Conical Microwave Imager Sounder (CMIS) will have its PDR in FY01. Two of these sensor suites, VIIRS and CrIS, along with NASA's Advanced Technology Microwave Sounder, are part of the NPP risk-reduction demonstration flight.

During FY00, agreement was reached on a charter to conduct, report, and provide oversight of NPOESS T&E activities to manage the complex Tri-agency T&E program. The charter provides for a Tri-agency CTF, composed of a multi-Service test force led by AFOTEC, and including NASA and NOAA operators and testers. The CTF is responsible for all testing, including DT&E, and will also conduct testing for NASA and NOAA requirements. The CTF will operate as the Operational Test Agency (OTA) for NPOESS, and will conform to Title 10 constraints on the use of development contractors. A sub-set of the CTF, known as the CTF Independent Council (CTF-IC), excludes contractors and the Integrated Program Office, and will be responsible for independent evaluation and assessment of test results. For purposes of assessing military effectiveness and suitability, DOT&E maintains the authority to approve the TEMP and operational test plans, and to provide an independent assessment to Congress.

TEST & EVALUATION ASSESSMENT

No assessment of operational effectiveness or suitability can be made at this time. NPOESS is still in the Program Definition/Risk-Reduction phase, only limited DT&E has been conducted, and no dedicated OT&E has been conducted on the program. DOT&E's current activities are concentrated on reviewing risk-reduction activities, helping to structure the test charter, developing the operational assessment plans and the TEMP, and ensuring that the program continues to evolve towards an operationally effective and suitable system.

NAVSTAR GLOBAL POSITIONING SYSTEM (GPS)



Air Force ACAT ID Program		**Prime Contractor**
Total Number of Satellites:	65	Block II, IIA - Rockwell
Total Program Cost (TY$):	$7,320M*	Block IIR – Lockheed Martin
Average Unit Cost (TY$):	$37.5M (Blk IIR)**	Block IIF – Boeing
Full-rate production:	3QFY89 (Blk IIR)	Ground Segment (SPI) - Boeing

**Includes all Space & Control and User Equipment TOA*

***Does not include modernization*

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The NAVSTAR Global Positioning System (GPS) is a 24-satellite constellation that provides highly accurate, real-time, all weather, passive, common-reference grid position and time information to military and civilian users worldwide. GPS enables the military forces to precisely determine their position, velocity, and time to: (1) enhance command and control and coordinate battle tactics and support; (2) engage in strategic and tactical warfare; (3) maneuver efficiently on the battlefield; (4) provide accurate and timely fire support; and (5) facilitate combat service support operations. In addition, knowledge of exact position and time is essential to reconnaissance and intelligence missions. GPS provides the precision, velocity, and time element of ***information superiority***, and serves as the cornerstone of the warfighter's ability to execute the ***Joint Vision 2020*** concept of ***precision engagement***.

GPS is an Air Force-managed Joint Service program and comprises three segments: space, control, and user equipment. The space segment consists of 24 satellites in semi-synchronous orbits around the earth. The original Block I satellites were replaced with Block II/IIA satellites. Currently, Block II/IIA satellites are being replaced with Block IIR as the II/IIA satellites fail on-orbit. The control segment consists of a master control station, four ground antennas, a pre-launch capability station, and five geographically dispersed monitoring stations. The control segment monitors satellite downlink signals and uploads corrections to diminish errors broadcast to users. The user segment consists of numerous forms of GPS receivers that use satellite downlink signals to determine position, velocity, and precise time. These receivers are hosted on a multitude of platforms and are classified into three general categories: high-dynamic sets (5+ channels); medium-dynamic sets (2 channels); and low-dynamic sets (usually single channel). Primarily the Air Force and Navy use the 5-channel sets on aircraft, ships, and submarines. The 2-channel sets are used mainly by the Army in heliborne configurations. The single-channel sets are generally used in hand-held applications.

BACKGROUND INFORMATION

DoD approved the NAVSTAR GPS program in December 1973. Full-scale development began in June 1979. By 1985, the Joint Program Office had launched ten Block I satellites and developed the associated ground-control system software to support system test and checkout. The first production satellite launched successfully in February 1989. The Block I satellites were followed by 27 Block II/IIA satellite launches. The initial operational capability, which included the control segment, was declared on December 8, 1993.

The first Block IIR satellite was destroyed during launch as a result of a Delta booster explosion on January 17, 1997. The first successful launch of a Block IIR satellite occurred on July 22, 1997. Currently, there are three Block IIR satellites on-orbit. The GPS IIR satellites provide the same functionality as earlier satellites, with added capabilities in two-way ranging and requiring less human interfacing for on-orbit operations. There are 19 additional Block IIR launches planned, with as many as 12 of these being the modernized or Block IIR-M version. The first Block IIR-M satellite launch is planned for FY03. The IIR-M capabilities add developmental military M-code on the L1 and L2 signals and civil use C/A code on the L2 signal. Block IIF satellites are also under development, with the first IIF satellite launch planned for FY06. The Block IIF satellites are functionally equivalent to the IIR/IIR-M satellites, plus completely operational M-code on L1 and L2, and a new civil signal, designated L5, operating at 1,176 MHz.

GPS user equipment development began in June 1979, with receiver testing (using Block I satellites) in a variety of land, sea, and air vehicles. Since then, numerous versions of single-, 2-, and 5-channel receivers have undergone development and fielding. GPS user equipment achieved full-rate production approval in January 1992. Full operational capability was declared in November 1995, after completion of Phase III IOT&E.

Active user equipment programs include the production of Miniaturized Airborne GPS Receiver (MAGR) 2000 in FY00 and FY01, followed by platform installations in FY01 and beyond; Defense Advanced GPS Receiver deliveries beginning in FY03; and M-code receiver deliveries beginning in FY07. All receivers produced after FY02 are to have the SAASM capability installed.

TEST & EVALUATION ACTIVITY

Space and control segment testing occurred in three phases. Phase I IOT&E was conducted from 1989-1990; Phase II IOT&E from 1990-1992; and Phase III from 1992-1994. Each test phase was successful and progressively led to an approved final operational capability, with a complete 24-satellite configuration. The Block IIA satellite constellation and ground system completed all operational test activities in prior years and are fully operational.

Testing and procurement of GPS user equipment began in the late 1980s and early 1990s with the 1-channel Manpack receiver and the 3A (airborne) and 3S (ships) receivers. The Manpack was replaced with the commercially developed SLGR and the advent of PLGR in 1993. A 2-channel receiver was also developed and tested in this timeframe, mostly for heliborne applications. The commercially inspired non-developmental item (NDI) MAGR was installed in aircraft in the early 1990s as an answer to space and weight constraints in many aircraft platforms. The NDI-procured Embedded GPS/INS receiver, the so-called EGI card, has also been installed extensively on platforms. Typically, NDI receivers are not subjected to the same rigorous test activity that predecessor receiver programs experienced.

An operational assessment of the first Block IIR satellite was conducted in July 1998. Although the IIR satellite met all navigation and timing requirements, a significant problem was found with the improved cross-link capabilities. The cross-link system sensed spurious radio frequency interference that inhibited completion of system tasks. An interim fix for the problem has been incorporated on the second and third IIR satellites, and a more robust resolution to the problem is being applied to the remaining Block IIR/IIR-M satellite family.

Future testing consists of completing the Block IIR test, implementing the Block IIR-M (FY03) and IIF (FY06) test programs, and the evolution of the control segment. Operational testing of the Block IIR portion of the GPS constellation will take place when seven to nine satellites are on-orbit, and will assess IIR effectiveness and suitability against documented requirements (SORD). The assessment will also determine the efficacy of the cross-link problem fix.

The modernized Block IIR satellites (M-code capable), designated IIR-M, are currently in production and scheduled for first launch in FY03. IIR-M capabilities to provide NAVWAR protection, backward compatibility with legacy receivers, and a new civil signal on L2 will be assessed when 1 to 3 IIR-M satellites are on-orbit. Control segment software version 5 will be tested in conjunction with Block IIR-M satellite tests.

The follow-on Block IIF satellites are scheduled for first launch in FY06. These satellites will also be M-code capable, and besides providing the civil signal on L2, will also provide a new civil signal on the L5 frequency. Testing of the Block IIF satellites will be performed along with Block IIR-M satellites, and will be done in conjunction with software tests for control segment versions 6 and 7.

IOT&E will occur when 24 operational Block IIR-M and Block IIF satellites are on-orbit and control segment software version 7 is operational. IOT&E will be a system-wide test of the space and control segments and legacy and future M-code capable user equipment. It is scheduled to take place in FY09-10.

TEST & EVALUATION ASSESSMENT

Ground testing and preliminary on-orbit testing indicates that the proposed solution to the Block IIR cross-link problem is being resolved satisfactorily. However, it is still too early to report a final determination of the effectiveness and suitability of the IIR satellites. The three successfully launched Block IIR satellites are performing their navigation and timing mission without any reported problems, and are expected to meet all navigation and timing requirements for the IIR system. Based on the history of the GPS program, the results of the operational assessment, and the efforts to correct the interference problem, DOT&E believes that the Joint Program Office is progressing satisfactorily toward fielding an effective and suitable space segment.

Continuing problems in the GPS Operational Control Segment are the basis of DOT&E's chief concern. Control software segment development continues to be a moderate to high-risk area with an ambitious schedule. There have been problems in incorporating the Government's Single Prime Initiative (one contractor for both space and control segments). A six-month delay occurred because new startup funds were not authorized until August 15, 2000. This lack of funding has seriously impaired system development and test schedules, which were already risky, with no margin to spare. Additionally, the contractor developing the replacement Operational Control System (version 3/4) continues to experience problems. Probable delays are expected in implementing the Block IIR-M and IIF systems, with the attendant M-code and civil signal capabilities. Development of M-code capable user equipment lags behind the development of the space and control segments, and this may also induce delays in testing.

The planned test approach provided in the new version of the GPS TEMP is straightforward and well thought out. Extensive joint developmental/operational testing is planned to ensure early and adequate insight into the new capabilities planned for inclusion into the GPS mission; i.e., second and third civil signals, and signal protection for U.S. and allied forces. The GPS TEMP has been updated to cover test activities for the associated control segment software and M-code functionality. Final OSD approval is expected in early FY01.

One shortfall that DOT&E has identified in the TEMP concerns the operational testing of ICD-compliant GPS cards that form the basis of next-generation UE. These new cards are to be Block IIA, IIR, IIR-M, and IIF compatible, and integrated into existing and yet-to-be-developed UE. The current test plans do not call for any operational testing of this UE in the near term other than in a static environment. Full testing of these cards, and associated electronics, will not occur until the as yet fully defined M-code capable receivers are available in the '07 timeframe. Before that time, we believe that backward compatibility and initial M-code performance of the new GPS cards must be tested in existing receivers integrated into operational platforms.

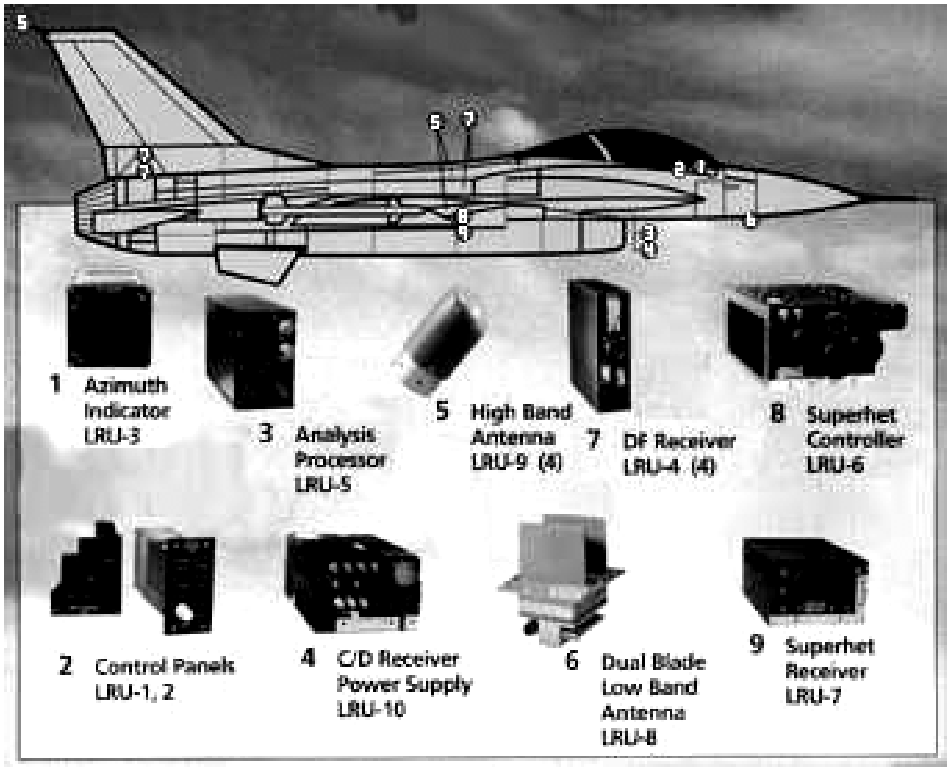
DOT&E continues to advocate the testing of this new UE, integrated into representative platforms (i.e., ships, aircraft, and land vehicles) as early in the program as possible. This testing could be conducted as operational assessments, followed by an end-to-end system test (IOT&E) in the 2009-2010 timeframe.

RECOMMENDATIONS

DOT&E considers control segment software development as a moderate to high-risk area, with an ambitious schedule that will be difficult to meet. The architecture has not been fully defined, and there are some problems with the implementation of the Single Prime Initiative. In the space segment arena, the M-code signal is not fully defined, and this uncertainty is beginning to impact development and test schedules. Resources should be brought to bear to ensure timely design and development of both control segment software and M-code signal generation on satellites. We will monitor this activity with respect to impacts on the testing schedule.

Early operational evaluation/testing of integrated UE, including testing on an inverted range, must take place in the 2004-05 timeframe to ensure backward compatibility with existing UE and discover shortfalls that might exist in the design of M-code receivers.

RADAR WARNING RECEIVER (RWR) AN/ALR-56M



Air Force ACAT III Program
Total Number of Systems: 533
Full-rate production: 2QFY93

Prime Contractor
Lockheed Martin Fairchild Systems

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The AN/ALR-56M Radar Warning Receiver (RWR) contributes to the ***Joint Vision 2020*** concept of ***full-dimensional protection*** by improving individual aircraft probability of survival through improved aircrew situational awareness of the radar guided threat environment. ALR-56M includes a fast scanning superhet receiver, superhet controller, analysis processor, low band receiver/power supply, and four quadrant receivers. It provides inputs to the ALE-47 CMDS (Countermeasure Dispenser System) to enable the selection and dispensing of chaff and/or flares for aircraft self-protection. The ALR-56M is designed to provide improved performance in a dense signal environment and improve detection of modern threat signals compared to the version of the ALR-69 that it replaced. A miniaturized version of the F-15's ALR-56C, the ALR-56M is a form and fit replacement for the ALR-69 RWR in the F-16 Block 40 and other aircraft. ALR-69 upgrades are underway for earlier blocks of F-16 and other aircraft. The ALR-56M is the RWR chosen for integration into the open architecture Defensive System Upgrade Program in the B-1B bomber Conventional Mission Upgrade Program. The ALR-56M upgrades are developed in conjunction with upgrades to the ALE-47.

BACKGROUND INFORMATION

A December 1992 DOT&E BLRIP report stated that AN/ALR-56M was effective and suitable. In addition, the 1992 DOT&E BLRIP report recommended FOT&E "because of the deferral of tactics verification testing and the concern about bearing errors and delayed deletions during extensive maneuvers." The current TEMP calls for additional ALR-56M testing as part of continuing Block 40 and Block 50 F-16 follow-on testing.

The National Defense Authorization Act for the Fiscal Year 1989 Conference Report directed that "all future operational results for RWR update programs be reviewed and approved by the Director of Operational Test And Evaluation, prior to obligation of production funds." AN/ALR-56M is such a program.

FOT&E has been conducted by the U.S. Air Force Air Combat Command (ACC), Air Warfare Center on subsequent software versions. ACC has continued routine upgrades to Mission Data Table software to keep pace with the changing electronic order of battle priorities for various geographical areas of operation. However, tactics verification testing during FOT&E resulted in notations in the ALR-56M User's Handbook concerning the operational significance of the performance problems considered to be training issues. Training is required to ensure that aircrews understand ALR-56M performance during maneuvering.

Operationally Significant Changes to the ALR-56M. Some of the major operationally significant changes associated with the latest software upgrade, Operational Flight Program (OFP) 0040, include the following:

- **SADS (Simulated Air Defense System) X Processing.** This change reduces ambiguities between the SADS X TTR (target tracking radar) and AI (airborne interceptor) radars.
- **Burst Enhancements.** This change reduces the number of multiple threat symbols associated with burst-ranging radars.
- **Missile Launch Audio Recycle.** Missile launch audio warning will now repeat instead of being a one-time initial warning.
- **Excess Maneuvering Fast Ageout and Redisplay.** During excess maneuvers, threat symbols will age out as soon as a break-lock occurs, and will re-display as soon as a new lock-on occurs.

The ALE-47 CMDS (Countermeasure Dispenser System) operational flight program (OFP) 9023 is concurrently being upgraded along with the ALR-56M OFP 0040 block changes. The ALE-47 CMDS is a software-controlled system designed to counter target tracking radars, radio frequency, and infrared missile seekers using chaff and flares. ALE-47 can dispense countermeasures using any of six pre-programmed manual programs. It can also use threat information from ALR-56M and aircraft altitude information from aircraft avionics to calculate optimal dispense programs for a given threat type, range, and azimuth. In AUTO mode, ALE-47 will automatically dispense calculated programs without pilot command. In semiautomatic, ALE-47 will dispense a calculated program only when the pilot commands activation.

Operationally Significant Changes to the ALE-47

- **Track File Ambiguity Message.** When the RWR determines a threat signal is ambiguous with one or more other threat signals, the OFP 9023 provides the capability for ALE-47 to consider the three highest priority ambiguities when calculating a dispense program.
- **Squib Failure Tracking.** Expendables that either fail to poll or misfire will be identified and discarded.
- **System Checkout.** This update provides the capability to complete a ground check of the ALE-47 system without having to load special mission data.

TEST & EVALUATION ACTIVITY

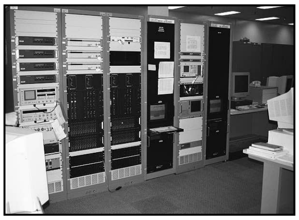
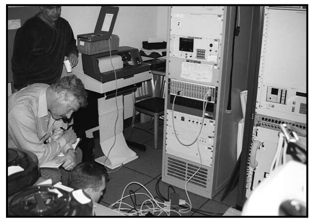
Desired changes to the fielded OFP are a culmination of user requirements consolidated and prioritized by Headquarters, Air Combat Command, Air Force. Some of these requirements include deficiencies noted in previous testing, desired enhancements targeted at handling evolving threats, as well as man-machine interface improvements directed at improving pilot situational awareness. A broad summary of those software changes include: (1) update of Mission Data threat parameters; (2) improved threat information interface with the ALE-47 expendable countermeasure dispensing system (OFP 9023); and (3) improved detection of emitters with complex waveforms.

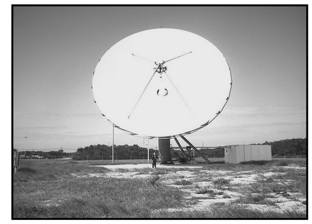
Developmental Flight Testing of ALR-56M 0040 OFP, the latest software version upgrade, occurred at the 416th Flight Test Squadron at Edwards AFB, CA, where over 20 developmental flight tests were conducted encompassing a variety of Air-to-Air and Air-to-Ground mission profiles. The system transitioned to the 36th Electronic Warfare Squadron at Eglin AFB, FL, where it entered Phase I Operational Testing (Familiarization & Training). Several significant deficiencies were discovered in both DT and OT, and the program was halted for corrections. The current schedule requires delivery of new, corrected software for DT in 4QFY00, followed by a combined DT/OT at Eglin during 1QFY01. A dedicated FOT&E is slipped until mid-FY01 at the earliest.

TEST & EVALUATION ASSESSMENT

Technical challenges to fielding the new software update center on resolution of problems with the new mission data generator, which requires an extensive update for the new software version. Challenges do not appear insurmountable, but will require continued use of early system integration and robust testing to resolve and produce an effective and suitable upgrade.

RANGE STANDARDIZATION AND AUTOMATION (RSA)



Air Force ACAT II Program		**Prime Contractor**
Total Number of Systems:	Infrastructure upgrades	Lockheed Martin
Total Program Cost (TY$):	$1.9B	
Average Unit Cost (TY$):	N/A	
MS II/III:	N/A	
IOC	Not defined	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

Range Standardization and Automation (RSA), which is referred to as Spacelift Range System (SLRS) programs by the System Program Office, addresses range equipment upgrades and standardization through a grouping of three contracts that will modernize and improve capabilities at the Eastern and Western Ranges, while attempting to reduce Operations and Maintenance (O&M) costs by 20 percent from the FY95 baseline. The overall program objective is to improve the SLRS while reducing total cost of ownership by: (1) centralizing command and control and data processing; (2) normalizing logistics support; (3) accelerating response to increasing launch processing and operational requirements; and (4) providing parallel launch operations support capability. RSA consists of products delivered in three distinct acquisition phases: RSA Phase I (at the Eastern Range only), RSA Phase IIA, and the SLRS Contract. The RSA Phase I and Phase IIA contracts will provide a system architecture and associated upgrades to the control/display and communications segments. The SLRS contract will continue modernization by developing and procuring an integrated suite of automated instrumentation, and will engineer and execute a proactive recapitalization process to replace hardware no longer sustainable.

The SLRS combines resources of two independently operated ranges: the Eastern Range managed at Patrick AFB, FL and the Western Range managed at Vandenberg AFB, CA. The SLRS consists of assets that enable the safe and effective launch, testing, and tracking of DoD civil, commercial, and international spacelift vehicles. Missions supported by SLRS systems include space shuttle landings, space surveillance, and ballistic missile, guided weapon, and aeronautical test and evaluation. The SLRS architecture consists of three segments at both the Eastern and Western Ranges: instrumentation, network, and control/display. The instrumentation segment consists of telemetry, command, metric, weather, area surveillance, and imaging sub-systems. The network segment consists of transmission, timing, and radio frequency monitoring sub-systems, and provides both inter- and intra-segment connectivity. The control/display segment consists of instrumentation control, network control, data processing, mission control, planning and scheduling, and meteorological control sub-systems. RSA implements standardized hardware, software, and procedures for both ranges. The standardized SLRS will improve operational efficiency through increased responsiveness, reliability and supportability and reduce O&M costs.

Standardization will be applied to the design of hardware and software and to procedures at the ER and WR. This standardization fosters ***interoperability*** and ***focused logistics*** by improving operational efficiency through increased responsiveness, improved reliability and supportability, and reduced O&M costs.

BACKGROUND INFORMATION

RSA addresses virtually every aspect of the range infrastructures at the Eastern and Western Ranges. Numerous shortcomings of the current range systems are described in the RSA Operational Requirements Document (ORD), which documents that range systems are becoming unsupportable. For example, 25 percent of the components required for the major range systems are obsolete and have no source of spares, requiring the ranges to rebuild/refurbish or reverse-engineer and manufacture parts. Poor reliability is causing more frequent system failures, which drives a need for more redundancy at increasing cost. This has forced ranges to become dependent upon their technical services contractors for unique depot maintenance and sustaining engineering support. Furthermore, the ranges lack responsiveness and are unable to support simultaneous operations. This is primarily due to manpower-intensive systems that take days to reconfigure and data processing systems and sensors only capable of single string operations. These factors limit the ranges' ability to meet future demands for government and commercial support.

Correction of these deficiencies began in FY96 with Improvement and Modernization (I&M) projects and RSA improvement contracts. I&M projects made improvements to the control/display, network, and instrumentation sub-systems, and RSA Phase I made improvements to satellite communications (SATCOM), telemetry [Centralized Telemetry Processing System (CTPS)], and the Cape Fiber Optic Network at the Eastern Range only. RSA Phase IIA is making upgrades to all three segments (instrumentation, network, and control/display) at both ranges, including weather, planning/scheduling, data infrastructure, communications, range safety, and control center operations consoles. RSA Phase IIA began in FY99 and will extend through FY05. The SLRS Contract, which was scheduled to begin in FY00 and extend through FY06, will make improvements to optics, surveillance, instrumentation, sustainment, and recapitalization.

RSA was one of the first programs to have requirements developed after implementation of acquisition reform. As a result, requirements were written at a high system level, and requirements allocations to sub-systems, and to acquisition phases, still need to be developed between the operating and developing commands. Numerous technical challenges for the developing command are having significant impacts on schedules, funding, and transition from legacy systems to RSA-delivered systems. This may require some of the current systems to run in parallel with the new RSA systems for an extended period at increased cost to the program office, the operating commands, and the operational units.

The RSA OT&E concept emphasizes combined developmental/operational test and evaluation and is structured to determine operational effectiveness and suitability in an operational environment. There are no dedicated OT&E test articles for RSA. AFOTEC will conduct dedicated operational testing on the incrementally delivered and full SLRS while operating in parallel with the existing SLRS at the Eastern and Western Ranges. Except for equipment installed to facilitate transition, testing will take place in the operational environment and under operational conditions to the maximum extent possible.

The OT&E concept includes three Operational Utility Evaluations (OUE) to coincide with the three contract actions (RSA Phase I, RSA Phase IIA, and SLRS Contract), prior to a final system-level IOT&E, which is scheduled to begin in FY06. The individual RSA OUEs will support an incremental process for gathering and analyzing relevant data leading to the final IOT&E, and will support fielding decisions by Air Force Space Command for each phase or operational capability delivery.

TEST & EVALUATION ACTIVITY

RSA was placed under DOT&E oversight in January 2000. This required the System Program Office to develop a TEMP, which is currently in progress. The TEMP will define the test concept, formulate Critical Operational Issues and Measures of Effectiveness/Performance, and identify required test assets. DOT&E participated in several TEMP development and issue resolution meetings.

AFOTEC conducted an OUE on portions of RSA Phase I at Cape Canaveral Air Force Station from June 1999-March 2000. RSA Phase I provides a new satellite communications network (SATCOM) with reliable communications on the Eastern Range, a fiber optics network on Cape Canaveral (CFON), and a Centralized Telemetry Processing System (CTPS) to standardize and automate telemetry configuration and processing. AFOTEC tested SATCOM and CFON and determined that the new systems could support operational space vehicle and ballistic missile test launches. In particular, these communications capabilities enhanced range safety by providing range safety critical telemetry through SATCOM terminals and real-time video feeds of launches through the CFON network to assist in launch safety determination. Delays in the creation of operational configuration files prevented testing of CTPS until FY01.

TEST & EVALUATION ASSESSMENT

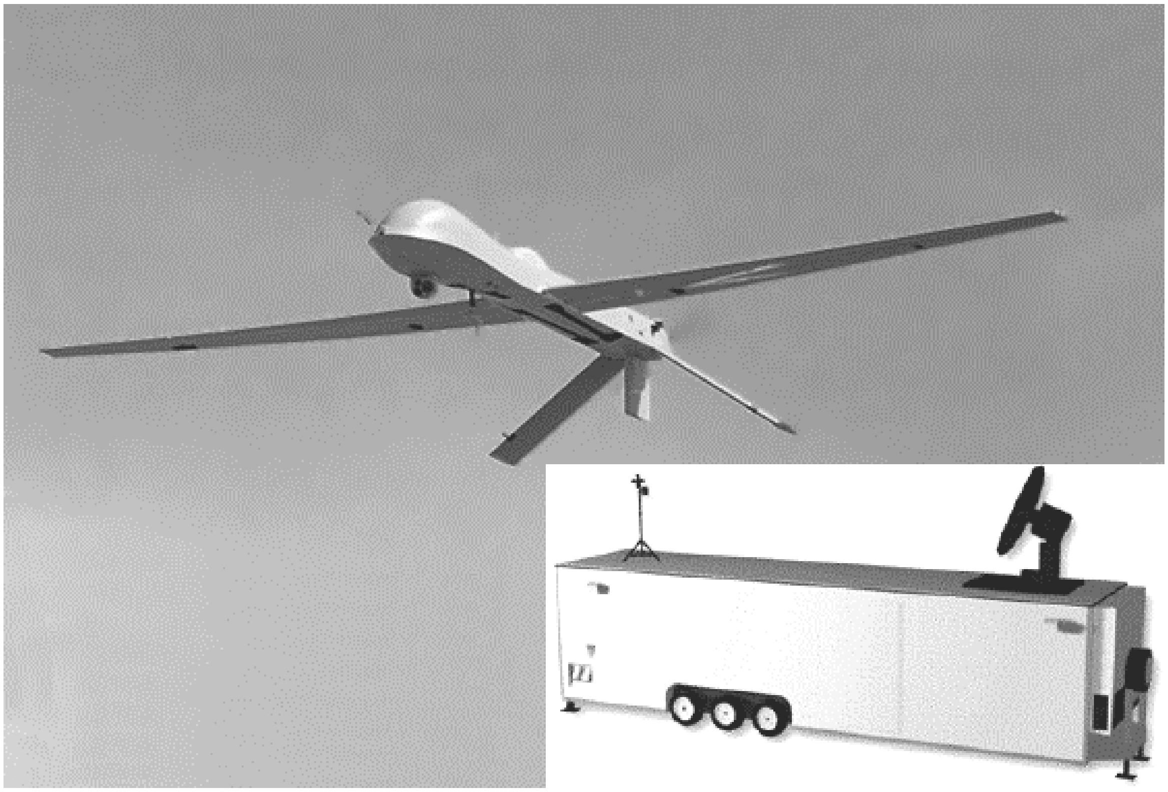
AFOTEC reported in their OUE Report for RSA Phase I that the SATCOM and CFON systems are ready for operational use. However, RSA Phase I systems fell short of the overall reliability requirement for the entire Spacelift Range System, as specified in the ORD. This was primarily due to only one of two planned SATCOM strings currently being in place. The OUE results predicted that ORD reliability requirements would be met once a planned second SATCOM string is installed. DOT&E concurs with AFOTEC's assessment and supports their recommendation that the new systems be used in parallel with legacy systems until a second SATCOM string is brought on line and reliability and dependability meet requirements. The OUE also identified some shortfalls in the supply of spares, software maintainability, and maintenance training. AFOTEC will provide a final assessment of the operational utility of all RSA Phase 1 deliveries following testing of the Centralized Telemetry Processing System, scheduled in late FY01. The OUE results demonstrated that Eastern Range communications through SATCOM and CFON are an improvement over the previous legacy system, and that SLRS systems are evolving towards an operationally effective and suitable system.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

In spite of the documented need for range modernization, there is fairly substantial resistance to implementation of RSA at the operational ranges, as well as concerns from external range users. The implementation resistance is due to uncertainty about what capability RSA will deliver compared to current systems operating at the ranges today, as well as changes to legacy routines that will be required by standardization. Standardization will require changes in the way the ranges operate and deliver data products and services. Uncertainty about the magnitude of the required changes has raised concerns within the range operator and range user communities. Other range operator concerns include how long they will need to continue operating two ranges (one with the legacy systems to meet current range requirements and one for the RSA systems under test) at each range location, and how long it will take to either integrate or replace legacy systems with RSA deliverables. In addition, range operators are concerned about unit funding impacts in support of RSA implementation, personnel training, and testing. External range user concerns focus on interoperability and how the new RSA deliverables will interface with legacy systems to meet all user requirements. For example, NASA and the National Oceanic and Atmospheric Administration have expressed concerns that RSA designs to standardize weather squadron operations will impact their interfaces with the ranges. Most of these issues are now being addressed in appropriate senior-level forums, but final resolution has not yet been attained.

Placing RSA under DOT&E oversight has helped foster additional discipline in the development and coordination of a coherent system-level RSA test strategy. However, there are residual issues involving Reliability, Maintainability, and Availability (RMA) modeling, O&M cost estimation methodology, and availability of CTPS configuration files that impact the test community. RMA modeling is hampered by the non-standardized methodologies employed at each of the ranges to capture and calculate historical RMA data. This has affected AFOTEC's ability to configure their RAPTOR model for RMA analyses and assessments. O&M costs are to be reduced 20 percent from baseline FY95 figures, but the lack of a rigorous methodology to estimate total range O&M costs makes it difficult for AFOTEC to determine whether this key performance parameter in the RSA ORD will or can be achieved. The inability of the operational unit to generate operational configuration files for CTPS has forced AFOTEC to delay CTPS operational testing until 4QFY01. In addition to these issues, the System Program Office needs to accelerate coordination of the TEMP for submission to DOT&E for approval.

RQ-1A PREDATOR UNMANNED AERIAL VEHICLE (UAV) SYSTEM



Air Force ACAT II Program		Prime Contractor
Total Number of Systems:	12	General Atomics Aeronautical Systems, Inc.
Total Program Cost (TY$):	604.9M	
Average Unit Cost (TY$):	20.5M	
Full-rate production:	1QFY00	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Predator medium altitude endurance Unmanned Aerial Vehicle (UAV) system is a theater asset that is to provide both cued and non-cued reconnaissance, surveillance, and targeting capability. The long dwell capability provides the theater commander with continuous 24-hour coverage of the area of interest. RQ-1A will help the in-theater CINC conduct ***precision engagement*** by helping provide ***information superiority***.

The Predator system comprises both air and ground segments. The air segment consists of four full composite air vehicles powered by a turbo-charged Rotax 914 engine. The air vehicle can carry simultaneously Electro-Optic (EO), Infrared (IR) and Synthetic Aperture Radar (SAR) sensor payloads. Four EO/IR payloads and three SAR payloads will be provided for each system of four air vehicles.

The system will be required to operate in less than ideal weather conditions, and a glycol weeping wing de-icing system was developed to provide the capability to transit through moderate icing conditions. Two sets of weeping wings will be provided for each system with four air vehicles. (The ability of the air vehicle to safely fly with the alternate weeping wings has not been demonstrated, however.) The Predator will fly at altitudes up to 25,000 feet Mean Sea Level, and data link systems between the air vehicle and the ground system include C-band Line-of-Sight (LOS), and Ku-band satellite for operations beyond LOS.

The ground segment consists of a shelter containing the Ground Control Station (GCS) and a Predator Primary Satellite Link (PPSL) for satellite communications between the air vehicle and the ground station. (Dissemination of imagery beyond the GCS is the responsibility of the supported commander.) The typical crew in GCS comprises one air vehicle operator and one sensor operator per flight shift.

BACKGROUND INFORMATION

In August 1997, Predator completed its transition from an Advanced Concept Technology Demonstration (ACTD) to an ACAT II acquisition program. Six systems were residuals from ACTD, and subsequently, three Production Rate Verification (PRV) contracts were awarded, bringing the total number of systems delivered or under contract to eleven. A twelfth system is still an option under the last PRV contract.

The Air Force Operational Requirements Document (ORD), approved in July 1997, delineated a number of system upgrades, with the top priorities being a de-icing capability, a UHF/VHF radio link for air traffic control through the air vehicle, improved Identification Friend or Foe transponders, and re-packaging of the GCS into a military style shelter. Other system capabilities upgraded from the ACTD to the baseline system are the more powerful turbo-charged Rotax 914 engine, relief on station capability, and reliability improvements. Predator system Number 6 was the first system retrofitted with all baseline capabilities and was used for initial operational testing. U.S. Air Force 11th and 15th Reconnaissance Squadrons at Indian Springs Air Force Auxiliary Field, NV currently operate Predator.

Three Predator systems deployed to Tuzla, Bosnia in 1999 to support Operation Allied Force. One of those systems was the baseline system Number 6that had been modified to incorporate a laser designator payload. Although some training and CONOPS development were done in theater, the laser-equipped Predators were never used in combat. On April 1, 2000, the baseline system Number 6, with technical orders, was delivered to the 11th Reconnaissance Squadron for training and preparation for IOT&E. (The laser designator payload is not part of the baseline system. It will be evaluated independently by the Air Force for its military utility and CONOPS development.)

The initial operation test was conducted during October 2000, after a total slip of more than three years. All the planned production contracts were awarded prior to operational testing so the operational test results will be used only to refine CONOPS and define any follow-on development efforts.

In January 2000, the Joint Requirements Oversight Council (JROC) approved a revised Tactical Control Station ORD. The revised ORD made interoperability between the Predator air vehicle and other Services' TCS-equipped ground stations an objective (vice threshold) requirement. TCS functionality in the Predator ground control station will be evaluated in follow-on tests. When all Services have fielded UAVs and TCS-equipped ground stations, a joint interoperability test will be conducted. Predator will be required to provide direct down link of imagery to another Services' TCS-equipped ground station.

TEST & EVALUATION ACTIVITY

Lessons learned from the operational deployment to Bosnia, as well as flight testing of Navy Predator's by the Naval Air Warfare Center, indicated that the target location accuracy of the Predator sensors could be in excess of one kilometer. Therefore, AFTOEC conducted several flight tests to analyze Predator's target location capability. Five flight tests were flown using three different aircraft between April and June of this year.

The AFOTEC-led Joint Reliability and Maintainability Evaluation Team (JRMET) collected and scored reliability data from all operational and training systems over a two-year period prior to the operational test. Most of the data were collected on non production-representative systems in non-operational environments; therefore, careful consideration of these data must be made prior to inclusion with any test results.

AFOTEC conducted the initial operational test at Indian Springs, NV during October 2000. The test consisted of two days of standalone sorties followed by taskings for seven days of 24-hour continuous flight operations.

The Joint Interoperability Test Center (JITC) worked with ACC to develop a prioritized list of C^4I nodes to be certified during IOT&E. The nodes include ATC, AWACS, DCGS, Trojan SPIRIT II, GCCS, TBMCS, and GBS. The JITC will only certify the joint-interfaces (i.e., GBS) but reviewed interoperability capability with the other Air Force nodes during operational testing.

TEST & EVALUATION ASSESSMENT

The baseline system flew 89.5 hours during its deployment to the Kosovo theater. During this time, the system experienced five operational mission failures resulting in a Mean Time Between Operational Mission Failure of 17.9 hours. While this is greater than that reported by the JRMET, it is still far less than the 40 hour requirement. No maintenance data were collected.

Results of the target location study indicate that the baseline Predator system had improved target location accuracy over the ACTD system, but that the ORD requirement for target location could not be met for some operational slant ranges. There is no requirement for slant range associated with the Target Location Error (TLE) requirements, however, other payload requirements such as target recognition and classification are required at 30,000 feet threshold and 60,000 feet objective slant ranges. A number of error sources were discovered that contribute to Predator's TLE including slant range to the target and the computational algorithm to predict the intersection of the sensor with the earth; the inherent accuracy of the digital terrain elevation data, boresight procedures (or lack thereof); positional error in altitude (differences in barometric versus GPS altitude up to 1000 feet were observed); sensor gimbal errors; induced errors (not keeping the crosshairs directly on the target); and bank angle. More target location data were collected during operational testing and will be presented in the test report.

The System Program Office (SPO) certified the Predator system readiness to enter operational testing with limitations regarding the wet wing sets, Effective Time On Station (ETOS) calculations, and the SAR sensor capability. Two pre-production wing sets were to be used for operational testing because the only two production wing sets were supporting real-world operations. However, prior to any flights with wet wings during the operational test, the 57th Operations Group Commander issued a restriction on flying Predator aircraft with wet wings. A deficiency was discovered that could have allowed the aircraft, with the wet wings installed, to fly below the stall speed if lost link conditions occurred. Because Relief On Station procedures require one of the two air vehicles to operate in lost link mode, the procedure was not deemed safe to operate with wet wings. The second limitation identified by the SPO prior to the test was that they would evaluate ETOS only for the dry wing configuration of the Predator system. Test data will only reflect the dry wing configuration, but the ETOS capability of a wet wing equipped Predator will be simulated based on the reduced endurance of that configuration. Finally, the SPO acknowledged that the SAR sensor would likely not be able to meet the JROC-approved key performance parameter requiring recognition of tactical sized targets at 30,000 feet slant range.

Endurance flights of the baseline air vehicle revealed a maximum endurance of approximately 20 hours for the dry wing configuration (with three-hour reserve) and 16 hours for the wet wing configuration. This was a large (and perhaps unexpected) trade-off of endurance for the more powerful turbo-charged Rotax 914 engine. Simulations of ETOS based primarily on endurance and reliability indicated that with these reduced endurances, a 75 percent ETOS could not be met at the maximum ranges of 400 nautical miles.

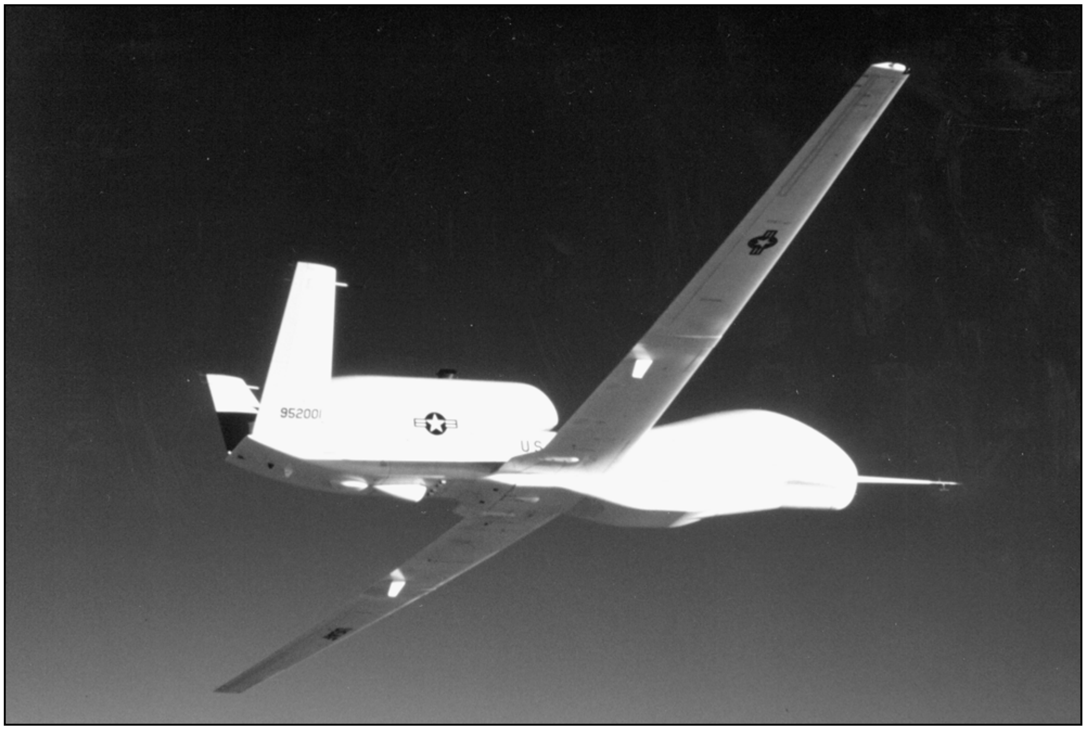
Five Predator air vehicles crashed between June and October 2000. At least three crashes were attributed to pilot error, while one crash resulted during the integration of a laser designator payload.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

Since no disciplined developmental testing was conducted on this system, many high-risk areas in performance remained prior to operational testing, and several limitations affected the conduct of the operational test. Furthermore, because all the production contracts were awarded prior to operational testing, motivation for testing and use of the test results were diminished.

Predator assets were often diverted from engineering development and testing for real-world deployments. Also, as a result of these operational deployments, the CONOPS for Predator evolved from one of strictly initial service release to include target acquisition and engagement. In this capacity, Predator assets were also diverted for other projects such as laser designation and weaponization.

RQ-4A GLOBAL HAWK UNMANNED AERIAL VEHICLE (UAV) SYSTEMS



Air Force Program		**Prime Contractor**
Total Number of Systems		Northrop Grumman (air vehicle)
Global Hawk Air Vehicles:	78	Ryan E-systems (ground segment)
Common Ground Segments:	16	
Total Program Cost (TY$):	$1.55B (FY01-07)	
Average Unit Production Cost (TY$):	$55M (per air vehicle & 25% cost of ground segment)	
MS II Production Review:	2QFY01	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Global Hawk Unmanned Aerial Vehicle (UAV) system is a theater commander's asset to satisfy broad area coverage and deep target surveillance and reconnaissance shortfalls. The Global Hawk air vehicle is to provide high resolution Synthetic Aperture Radar (SAR) and Electro-Optical/Infrared (EO/IR) imagery at long range with long loiter times over target areas. Potential missions for the Global Hawk cover the spectrum of intelligence collection capability to support joint combatant forces in worldwide peace, crisis, and wartime operations. These systems will support the in-theater CINC in ***precision engagement and full-dimensional protection through information superiority***.

The Global Hawk UAV system comprises an air vehicle segment consisting of air vehicles with sensor payloads, avionics, and data links; a ground segment consisting of a Launch and Recovery

Element (LRE), and a Mission Control Element (MCE) with embedded ground communications equipment; a support element; and trained personnel.

The Global Hawk air vehicle is optimized for long range and endurance; it should be capable of providing 24 hours on-station at a 1,200-nautical mile range from the launch site. It has a wingspan of 116 feet and length of 44 feet, and has a cruise speed of 350 knots. The maximum operating altitude is 65,000 feet mean sea level, although it is capable of providing imagery once above 56,000 feet above ground level.

The Integrated Sensor Suite (ISS) consists of a synthetic aperture radar (SAR), electro-optical (EO), and infrared (IR) sensors. Either the EO or the IR sensors can operate simultaneously with the SAR. Each of the sensors provides wide area search imagery and a high-resolution spot mode. The SAR has a ground moving target indicator (GMTI) mode. GMTI data are transmitted as a text product providing moving target location and radial velocity. Both SAR and EO/IR imagery are processed onboard the aircraft and transmitted to the MCE as individual frames. The MCE can mosaic these frames into images prior to further dissemination.

Navigation is via inertial navigation with integrated Global Positioning System updates. Global Hawk is intended to operate autonomously and "untethered" using a satellite data link (either Ku or UHF) for sending sensor data from the aircraft to the MCE. The common data link can also be used for direct down link of imagery when the UAV is operating within line-of-sight of users with compatible ground stations.

The ground segment consists of an MCE for mission planning, command and control, and image processing and dissemination; an LRE for controlling launch and recovery; and associated ground support equipment. (The LRE provides precision differential global positioning system corrections for navigational accuracy during takeoff and landings, while precision coded GPS supplemented with an inertial navigation system is used during mission execution.) By having separable elements in the ground segment, the MCE and the LRE can operate in geographically separate locations, and the MCE can be deployed with the supported command's primary exploitation site. Both ground segments are contained in military shelters with external antennas for line-of-sight and satellite communications with the air vehicles.

BACKGROUND INFORMATION

The Global Hawk program began as part of the High Altitude Endurance (HAE) Advanced Concept Technology Demonstration (ACTD), which included both the Global Hawk and the Dark Star UAV programs. The ACTD began in 1995 under Defense Advanced Research Projects Agency management, and in October 1998 transitioned to the Air Force systems program office at Wright Patterson AFB. The Dark Star program was cancelled in January 1999. The Global Hawk portion of the ACTD was conducted in three phases: design; development and test; and deployment and evaluation. The deployment and evaluation phase was conducted between June 1999-June 2000, with the U.S. Joint Forces Command as the operational sponsor. At the conclusion of the ACTD, USJFCOM declared the Global Hawk had military utility and submitted a military utility assessment in September 2000 to support the transition from an ACTD to an acquisition program.

In August 1999, OSD issued an Intelligence Program Decision Memorandum directing the Air Force to initiate an acquisition program with a Milestone II decision at the end of the FY00. The Air Force subsequently developed an acquisition strategy that is based on a spiral development process leading to Global Hawk air vehicles that satisfy the needs identified in the Military Utility Assessment and validated in the Operational Requirements Document in separate block configurations. The desired operational requirements were prioritized and each spiral will include those upgrades that available funding can afford. The full operational capability identified by the Air Force in the ORD will not be available until the second spiral or Block 10 systems are produced.

Five Global Hawk air vehicles were produced and delivered to Edwards AFB during the ACTD, and two more are under contract. Once the additional air vehicles and payloads are delivered, four air vehicles, two mission control elements, three launch and recovery elements, two SAR payloads, and one integrated sensor suite (with EO/IR and SAR) will be residual assets from the ACTD.

Global Hawk had its first flight in February 1998, and completed 58 sorties totaling 719.4 flight hours throughout the ACTD period. A crash in March 1999 destroyed air vehicle Number 2 and its sensor suite, and a runway incident in December 1999 damaged air vehicle Number 3 and destroyed the only other integrated sensor suite. Consequently, no EO/IR imagery was available during any warfighting exercises. A separate SAR sensor provided imagery.

Following the runway incident in December 1999, the Air Force Flight Test Center took over responsibility of flight safety and grounded the system until March 2000. As a result, participation in five out of the final seven planned exercises was cancelled. This is significant because these seven exercises were to be the core of the military utility assessment.

Due to the nature of an ACTD program, documentation capturing the requirements, operations, and testing strategy have been necessarily conducted along parallel paths. Prior to the Milestone review and approval authority to enter EMD and LRIP, however, four key elements must be available: a JROC-approved ORD, a Service-approved CONOPS, an Acquisition Strategy, and a TEMP. This documentation is necessary to provide the warfighter with the most effective and suitable system possible.

TEST & EVALUATION ACTIVITY

The year-long demonstration and evaluation phase for military utility assessment (June 1999–June 2000) was conducted with a “crawl, walk, run” approach, beginning as a non-obtrusive participant in exercises with a gradual increase in importance as an exercise participant, finishing with full integration into the theater collection and operations infrastructure. Between October-November 1999, the program continued the walk phase by participating in extended range missions (ER 3 and 4) over many western training ranges in California, Nevada, Idaho, and Utah. ER 4 was the first over-water flight and also included operations over the Cope Thunder ranges in Alaska. The final two exercises in the walk phase were the Joint Task Force Exercise-West including maritime, littoral, and inland operations, and the Combined Joint Task Force-Six (CJTF-6) along the U.S. Mexican border.

A runway incident in early December 1999 destroyed the second and only available Integrated Sensor Suite (ISS), the system was grounded until March while the Air Force Flight Test Center reviewed all safety procedures. (The first ISS was destroyed when AV-02 crashed in March 1999.)

Flight-testing resumed in March with AV-01; and in April, an LRE deployed to Eglin AFB, FL while the Mission Control Element deployed to Suffolk, VA. AV-04 self-deployed on a flight from Edwards AFB, California to Eglin AFB. Participation in two exercises, Linked Seas and JTFEX-00, occurred during this deployment. The entire system re-deployed to Edwards AFB in June 2000.

Flight testing of AV-05 began on June 30, 2000.

TEST & EVALUATION ASSESSMENT

The walk phase included participation in four exercises in a three-month period between October and December 1999. During all exercises, the Global Hawk launched from and landed at Edwards AFB, and the missions were monitored via the MCE at the contractor's facility in San Diego, CA. Operations took place over several western training ranges in California, Nevada, Idaho, Utah, Alaska, Arizona, and along the U.S.-Mexican border. Throughout the walk phase, six sorties were flown to completion, three were cancelled, and three had air aborts. The first two exercises (four sorties) were conducted with AV-01 and a SAR sensor. The second two exercises (five sorties) were conducted with AV-03 and a full ISS (EO/IR/SAR). Only SAR imagery was disseminated during any exercises; the EO/IR sensor was still undergoing engineering evaluation prior to being destroyed during the runway incident in December. New accomplishments of the Global Hawk during the walk phase included over-water operations, operations above 65 degrees north latitude, and direct down link of imagery to a JSIPS-N at Fallon, NV. However, the Global Hawk was never fully integrated into any exercise or training scenario during this phase, and this limited the ability to collect data on military utility or effectiveness. Except for the direct down link demonstration at Fallon, imagery was typically transmitted to the MCE and then re-transmitted to multiple user sites. Some imagery was also disseminated via the Global Broadcast System (GBS) to the USS Coronado, although those images had to be chipped from their full 80 megabytes to 6-megabyte chips.

The run phase consisted of a deployment to Eglin AFB, participation in two exercises, Linked Seas and JTFEX-00, and a re-deployment to Edwards AFB. On April 20, 2000, AV-04 flew a 10.5-hour flight from Edwards AFB to Eglin AFB. During this flight some pre-planned imagery orbits were cancelled because of a low temperature anomaly that necessitated an early landing. Subsequently, Global Hawk AV-04 flew two sorties in support of Linked Seas. Both sorties were planned to provide imagery of littoral areas near Portugal after making the transatlantic flight and then to return to Eglin AFB. The first sortie lasted 28 hours and accomplished the first trans-oceanic flight of Global Hawk, including operations in international air space. During the initial part of the flight, SAR imagery was transmitted from the MCE to Ft. Bragg, but attempts to direct down link to the USS George Washington were unsuccessful. Once in theater, none of the Portuguese scenes on the collection plan were collected because of a SAR transmitter failure; one re-task scene from Portugal was captured although image quality was reported as poor. The second Linked Seas sortie lasted 14.1 hours. Problems communicating with the UHF satellite precluded the trans-oceanic portion of the mission. SAR imagery was collected along the U.S. East Coast, and three scenes were transmitted via direct down link to the USS George Washington.

The Global Hawk flew two sorties in support of JTFEX-00: the first lasted 22.5 hours and the second lasted 14.7 hours. Imagery was collected and disseminated via direct down link to the USS George Washington and the Army TES at Cherry Point, NC. GBS dissemination during JTFEX was not successful. During the second sortie, a mission computer failure necessitated an early landing. The air vehicle remained at Eglin for about a month until the problem was found and fixed; on June 19, 2000

AV-04 re-deployed to Edwards AFB. Due to problems with the sensor and mission computer interface, no imagery was taken during that flight.

After the re-deployment, the remaining scheduled exercises in the run phase, including a Canadian exercise, were cancelled because of technical issues associated with the verification and validation of the mission planning software.

Throughout the ACTD, system maintenance and operations depended heavily on development contractors. The only military operators and maintainers familiar with Global Hawk are part of the 31st Test and Evaluation Squadron. No operational squadron or home base has yet been identified for the Global Hawk.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

The accelerated nature of an ACTD program makes syncing the test and acquisition strategy more difficult than in a traditional program. For Global Hawk, DOT&E worked with the System Program Office and the Air Force test and evaluation community to establish a credible test strategy to support the Milestone II decisions to enter EMD. In this case, the several block upgrades comprising the first spiral will not meet the full requirements from the user, making assessments of operational effectiveness and suitability difficult. However, DOT&E is working, through the IPT process, to establish meaningful thresholds for the initial block systems.

Another result of the ACTD process is the availability of residual assets for test, exercise participation, and real-world deployments. Careful planning is necessary to ensure that enough assets are available so that residual operations and development and testing can occur simultaneously.

SENSOR FUZED WEAPON (SFW)

Air Force ACAT IC Program		**Prime Contractor**
Total Number of Systems:	5,000	SFW: Textron Systems Corporation
Total Program Cost (TY$):	$2060.2M	WCMD: Lockheed Martin
Average Unit Cost (TY$):	$0.334M	
Full-rate production:	3QFY96	
SFW P3I:	4QFY01/02	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The CBU-97/B Sensor Fuzed Weapon (SFW) is a 1000 pound class, unpowered, air-delivered, wide area cluster munition designed to provide multiple kills per pass against armored and support vehicles. The system has been certified on the A-10, B-1, B-2, B-52, F15, F-16 and is designed to be compatible with various USN/USMC, and NATO aircraft. The weapon has the capability of being delivered in adverse weather conditions, day or night, at various altitudes and airspeeds. SFW consists of a SUU-66/B Tactical Munitions Dispenser (TMD), which houses ten BLU-108/B submunitions. Each submunition contains four projectiles, an orientation and stabilization system, a radar altimeter, and a rocket motor. After spin-up and release from the submunitions, the projectiles scan the area under their flight path with a two-color passive infrared sensor, while signal processing logic classifies and filters out false targets. Upon detecting a valid target, an electronic pulse detonates an explosive charge, driving an explosively-formed penetrator (EFP), an aero-dynamically stable slug, into the target. The SFW will be stored and transported as an all-up-round in the CNU-411A/E container. For typical tactical sorties, a combat load consists of four to six CBU-97/Bs. The SFW can be delivered at low or high altitudes (200 feet AGL to 40,000 feet MSL (w/ Wind Corrected Munitions Dispenser (WCMD) tail kit)) and at low through supersonic speeds (250-650 knots). The SFW program is closely related to the WCMD and Joint Standoff Weapon (JSOW) Programs. SFW will begin to be retrofitted with WCMD tail kits in April of 2001. All SFWs will be retrofitted with the WCMD tail kit and will become CBU-105s. The SFW BLU-108 submunition will be a payload in the JSOW AGM-154B. SFW supports the ***precision engagement*** component of ***Joint Vision 2020.***

BACKGROUND INFORMATION

The SFW program entered full-scale development in 1985. After a DAB program review, USD(A&T) authorized LRIP in March 1992. In November 1994, USD(A&T) delegated the full-rate production decision to the Assistant Secretary of the Air Force for Acquisition. The Air Force Milestone III Acquisition Decision Memorandum was signed in June 1996.

Due to range safety restrictions, CBU-97/B IOT&E testing was restricted to deliveries below 3,000 ft AGL. Therefore, system effectiveness from high altitude releases (above 3,000 ft AGL) was not validated. The effects of launch transients, ballistic errors, and unknown winds on TMD performance from medium to high altitudes, could not be validated. The BLRIP report submitted in May 1996 determined that SFW has only been proven operationally effective when employed at low altitudes using level or shallow angle dive deliveries.

The Wind Corrected Munitions Dispenser program was implemented to expand SFW employment options based upon a change to the Air Force's air doctrine. SFW was designed for low altitude, direct attack delivery profiles consistent with cold war, European scenario tactics. DESERT STORM experience resulted in air doctrine favoring high altitude deliveries, well outside the SFW's original concept of operation delivery mode. The WCMD program optimized SFW targeting to reflect the change in air doctrine favoring high altitude releases.

The Wind Corrected Munitions Dispenser is an inertial guidance tail kit that replaces the existing tail section of current inventory area attack weapons, including the Sensor Fuzed Weapon, to improve delivery accuracy when released from medium to high altitude. The Sensor Fuzed Weapon with the Wind Corrected Munitions Dispenser is designated as a CBU-105.

In 1996, the Air Force instituted a Preplanned Product Improvement (P3I) program as a low-cost force multiplier performance upgrade to the CBU-97A/B. The P3I program involves three major improvements: (1) improving performance against countermeasures; (2) altering the warhead design to improve performance against softer targets without degrading the current target-set performance; and (3) raising the radar altimeter height of function to increase area coverage. The current sensor will be upgraded from passive-only to a dual-mode active passive type. This upgrade will enhance the sensor's performance against cooler targets and improve weapon aimpoint. The Sensor Fuzed Weapon P3I submunition is designated a BLU-108B/B and the "all-up-round" is designated the CBU-97B/B.

Two Producibility Enhancement Program (PEP) hardware upgrades were initiated for SFW to reduce costs and improve producibility through design improvement. The first, PEP-1, involves electronic and mechanical changes to the projectile. The second, PEP-2, involves redesign of the sequencer and altimeter into one integrated submunition electronics unit.

The Sensor Fuzed Weapon TEMP was updated and approved in July 2000 to reflect changes in the test program. FOT&E 1 was completed in 1998. All objectives were met and testing results indicated that PEP-1 changes have not degraded the performance of the Sensor Fuzed Weapon. However, the PEP-2 program, and subsequently FOT&E 2, were cancelled due to technical problems. Critical technology elements from the PEP-2 program are being integrated into the P3I program.

Program delays for Sensor Fuzed Weapon P3I led to the development of an interim configuration (BLU-108C/B) for the JSOW AGM-154/B, incorporating only an insensitive munitions fill—PBXW-11. This submunition is planned for incorporation in the initial production configuration of the Joint Standoff Weapon (JSOW) AGM-154B.

The CBUs experienced premature high altitude dispenses in Sensor Fuzed Weapon lot acceptance testing and Wind Corrected Munitions Dispenser Developmental Testing. An Air Force Red Team determined the most probable cause of failure to be the proximity fuze. Analysis showed that occurrence of early opening events fell within stated reliability of the FZU-39 fuze. The Sensor Fuzed Weapon will be retrofitted with a cable similar to the CBU-87. The cable, running from the nose to the tail, will allow the WCMD tail kit to inhibit early dispense.

The DOT&E-approved LFT&E strategy for SFW P3I will be completed in two phases. Phase I will include: (1) collection of sensor data against a representative target set to determine impact points; (2) warhead performance data against armor plate targets; and (3) three test shots that repeat shotlines from the original SFW testing in 1990. An optional Phase II test will consist of a maximum of seven additional tower shots determined after the results of Phase I have been reviewed.

TEST & EVALUATION ACTIVITY

The Sensor Fuzed Weapon P3I underwent developmental testing during FY00. During initial warhead characterization testing in Apr 00, a warhead discrepancy was discovered. Warhead examination revealed a loose liner and loose explosive billet. This condition was evident in 26 of 28 warheads examined. Characterization testing was halted, fixes were incorporated into the design and characterization testing resumed on 25 September. The fixes included crimping, sealer, adhesive, and environmental conditioning. LFT&E Phase I events were completed in Dec 00, delayed due to a second warhead investigation. Results are being analyzed. The second corrective action taken was the elimination of the powder overfill initially included after the first warhead discrepancy. Current warhead corrective actions now include a new liner crimp and fill-lower housing adhesive.

In early CY 00, the SFW contractor, conducted live development flight tests of the P3I SFW. Results from these tests provided enough confidence to proceed into qualification testing. The Government began Sensor Fuzed Weapon P3I DT/OT flight test in Sep 00 and is scheduled to complete in Feb 01 using operationally representative delivery profiles, including WCMD.

Wind Corrected Munitions Dispenser IOT&E flight test completed Jun 00.

The SFW Program Office conducted two qualification flight tests from high altitude to verify FZU-39 assembly line quality improvements. Further testing of the early dispense inhibit will be conducted during the WCMD LRIP III test program. Four to five high altitude SFW drops are planned with the new cable and WCMD tail kit.

FOT&E III for end-to-end testing of the P3I configuration is currently planned to begin FY02 using the first production weapons.

TEST & EVALUATION ASSESSMENT

Operational testing of the Wind Corrected Munitions Dispenser demonstrated additional Sensor Fuzed Weapon employment capability from medium and high altitude. However, the Sensor Fuzed Weapon program encountered schedule delays due to development problems with the planned P3I.

Wind Corrected Munitions Dispenser test results resolved the outstanding issues from the Operational Test and Evaluation Report on the Sensor Fuzed Weapon (CBU-97/B) on medium and high altitude performance. AFOTEC rated the overall Wind Corrected Munitions Dispenser, including the Sensor Fuzed Weapon, CBU-105, as operationally effective and suitable when employed against the design target set. Weapon accuracy exceeded requirements. Weapon reliability met requirements. for operational life for both threshold platforms, number of power-on cycles to failure and weapon power-on cycle time. WCMD did not meet the requirements for storage reliability, service life and mission reliability. Additionally, while no significant problems were encountered with the F-16, WCMD did not prove to be interoperable with the B-52H due to a number of weapon built-in-test failures and a lack of display of weapon status. All deficiencies identified above have been corrected and confirmed through regression testing during the IOT&E timeframe. AFOTEC recommended end-to-end test including weapon releases with corrections before release to operational B-52 units.

Premature high altitude dispenses in Sensor Fuzed Weapon lot acceptance testing and Wind Corrected Munitions Dispenser Developmental Testing experienced by CBUs and attributed to the proximity fuze did not occur during operational testing. FZU-39 assembly line quality improvement qualification flight test results met specification requirements.

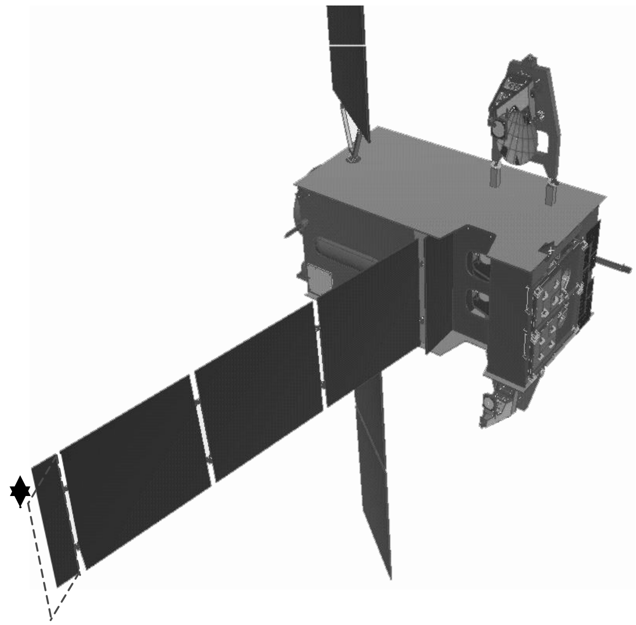
Delays in the P3I submunition development affected the planned cut-in date for P3I into both Sensor Fuzed Weapon and Joint Standoff Weapon and will result in the procurement of fewer P3I versions of these weapons. The combined DT/OT will provide results for P3I cut-in decision. However, the delays led the Joint Standoff Weapon AGM-154B program to plan initial production with the BLU-108C/B submunition, which lacks P3I improvements.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

The incorporation of the PBXW-11 IM fill has proven to be more difficult than anticipated. With “drop-in” explosive fill substitutions for IM and cost reasons proposed, the technical challenges should not be underestimated.

Emerging results of DT/OT TMD drops with BLU-108B/B submunitions and contractor test results suggest that LFT&E optional Phase II Tower Test shots are necessary to examine the lethality of the MEFPs against light armor and truck targets.

SPACED-BASED INFRARED SYSTEM (SBIRS)



DoD ACAT ID Program		**Prime Contractor**
Total Number of Systems:	4 GEO; 2 HEO Payloads; Approx 30 LEO Satellites	Lockheed Martin (High); TRW/Raytheon and Spectrum Astro/Northrop Grumman (Low)
Total Program Cost (TY$):	$7,613M (excludes low component)	
Average Unit Cost (TY$):	Varies by component	
First Satellites:	FY02 (HEO delivery) FY04 (GEO launch) FY06 (LEO launch)	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Spaced-Based Infrared System (SBIRS) replaces the current Defense Support Program (DSP). SBIRS improves support to theater CINCs, U.S. deployed forces and allies by providing better data quality and timeliness in four mission areas: Missile Warning, Missile Defense, Technical Intelligence, and Battlespace Characterization. By increasing the quality and timeliness of missile warning data over that provided by the Defense Support Program, SBIRS enhances ***information superiority*** and supports the operational concepts of ***full-dimensional protection*** and ***precision engagement***, providing data directly to theater commanders in a timely and survivable manner, thus enabling U.S. forces to immediately react to a threat.

The SBIRS space segment includes a High and a Low component. The High component comprises six satellites: four in geosynchronous (GEO) earth orbit, with first launch in FY04, and two hosted payloads in Highly Elliptical Orbit (HEO), the first of which will be available in FY02. A fifth GEO satellite will be procured as a replenishment/spare. The Low component includes approximately 24

Low Earth Orbit (LEO) satellites, and several spares, with first launch in FY06. SBIRS High satellites will primarily improve current DSP operational requirements for missile warning, technical intelligence, and battlespace characterization. SBIRS Low satellites will provide a mid-course tracking capability and discrimination data critical for effective ballistic missile defense.

The SBIRS ground segment is being acquired in three increments. Increment 1, whose IOT&E is scheduled to begin in FY01, consolidates DSP and Attack and Launch Early Reporting to Theater (ALERT) ground stations into a single CONUS ground station, and will operate with DSP satellite data. Increment 2 upgrades Increment 1 software and hardware with the functions necessary to incorporate HEO sensor payloads and operate the new GEO SBIRS satellites. Increment 3 will provide the functionality necessary to operate SBIRS Low satellites.

BACKGROUND INFORMATION

The SBIRS High component entered the EMD phase following a Milestone II DAB review in October 1996. SBIRS Low entered the Program Definition and Risk Reduction (PDRR) phase with Milestone I approval in August 1999, and two competing PDRR contracts were awarded.

Based on a restructured FY00 budget, the Air Force made substantive programmatic changes to both the SBIRS High and SBIRS Low systems during FY99. For the SBIRS High system, the Air Force delayed launch of the first GEO satellites from FY02-FY04, and re-scheduled incremental deliveries of the ground segment to align with the delayed satellite schedule. For the SBIRS Low satellites, the Air Force delayed first launch from FY04-FY06, and cancelled two proof-of-concept demonstration satellites, the Flight Demonstration System and the Low Altitude Demonstration System.

To mitigate the increased risk due to cancellation of the flight demonstrations, DOT&E influenced the Department to direct the Air Force to develop an acquisition strategy with significant design flexibility in the first six satellites, and a one year launch hiatus following those first six. The launch hiatus would allow sufficient testing to support a return-to-flight decision on the remaining satellites.

TEST & EVALUATION ACTIVITY

The SBIRS test concept is built around a combination of operational assessments, combined developmental/operational testing, and dedicated IOT&E. These operational test and evaluation events progress in a building-block manner beginning with analyses, modeling and validated simulation, and ending with Hardware-in-the-Loop test beds and field tests on ground systems and on-orbit satellites.

As a consequence of the FY99 programmatic changes, the House Appropriations Committee (HAC) asked DOT&E, in the Fiscal Year 2000 DoD Appropriations Bill, to submit an assessment of whether the SBIRS High acquisition strategy allowed for adequate testing to support a production decision. In December 1999, DOT&E reported to the HAC that SBIRS High testing would be adequate to support evaluation of operational effectiveness and suitability if the test program included a number of test events and resources. Required test events included sensor payload performance, functional and environmental tests; space vehicle functional and environmental tests; intersegment tests between the space vehicle and the ground segment; and system-level tests of the combined ground/space segment. Required test resources included a calibrated cryo-vacuum chamber with scene and target projection capabilities, allowing infrared projection of realistic earth background clutter and missile flight intensities and kinematics onto the sensor's focal plane.

Increment 1 breached its initial operational capability baseline on February 29, 2000, and the developer and contractor have been working since then to stabilize software and hardware development and performance before beginning operational tests. The major problems that led to the breach involved ground software development and integration. Deficiencies included mission software instability, insufficient operational dependability, and Tracking, Telemetry, and Control errors. At present, the program expects Increment 1 to be ready for dedicated IOT&E in 3QFY01.

Increment 2 ground facilities, originally scheduled to be operationally available in FY03 (ahead of the GEO satellites), have been delayed to FY05, coinciding with operational turnover of the first GEO satellite. The ground and space segments will be simultaneously turned over to the user in FY05 as a turnkey system. This reduces overlap between the delayed Increment 1 deliveries and the previous Increment 2 delivery schedule, but increases concurrency risk between the SBIRS High ground and space segment deliveries.

SBIRS High satellite T&E activity during FY00 included HEO component-level qualification testing, development of a new Advanced Sensor Test and Integration Facility (ASTIF) to support sensor payload qualification and acceptance testing, and re-design of the GEO satellite from a plane flyer to a solar flyer. Component-level HEO testing at factory plants included qualification tests of the Focal Plane Assembly, the Analog Pre-Processor, and the Optical Telescope Assembly. HEO payload qualification tests at the ASTIF, located at the Aerojet facilities in Asuza, CA, will begin in spring 2001, and GEO qualification tests will begin in 4QFY02.

SBIRS Low T&E activity during FY00 included development of contractor models, simulations, and facilities to conduct PDRR-level ground demonstrations of Critical System Performance Characteristics in preparation for Milestone II and entry into the EMD phase in FY02.

TEST & EVALUATION ASSESSMENT

Progress on Increment 1 software development has improved greatly. The current process improves configuration management and provides better government and contractor management visibility and measures to monitor progress. Continuing delays, however, remain a concern, and further Increment 1 schedule breaches would have serious impacts on Increment 2 deliveries and on the supportability of existing DSP and ALERT ground systems.

The revised Increment 2 strategy delays fielding of an operational, certified, Increment 2 ground segment until FY05, coincident with operational turnover of the first GEO satellite. Although this does not significantly delay the SBIRS High operational capability delivery to the user, it increases the risk of having to operate an on-orbit asset without a certified operational ground segment should Increment 2 ground software encounter similar delays to what has been experienced with Increment 1. To mitigate this risk, the Program Office is relying on an Interim Mission Control Station Backup (IMCSB) to develop Increment 2 software, to test and process data from the first HEO payload, and to test and control the first GEO satellite while a permanent Mission Control Station Backup (MCSB) is constructed. Once the MCSB is finished, it would be tested and certified for Increment 2 operations, and the MCS could then be upgraded from Increment 1 to Increment 2. While this provides significant risk mitigation, further steps should be taken to include plans for operational certification of the IMCSB should MCSB construction be delayed, or should MCSB software development and integration encounter similar problems to those found in Increment 1. Furthermore, the need dates for the GEO satellites should be reviewed in FY03 and FY04, based on DSP health and Ballistic Missile Defense needs, to ensure that on-orbit assets are not deployed too far ahead of a certified ground segment.

For SBIRS High satellite testing, DOT&E's December 1999 recommendations to the HAC are all being implemented, with the exception of adequate scene and target projection capabilities at the ASTIF. Instead, the developer plans to rely on data from previous tests on an Engineering Test Model (ETM) of the flight sensor from which to validate modeling and simulation for performance assessments. In September 2000, DOT&E advised the Program Office that this approach was not adequate due to differences between the ETM and the flight design, and due to calibration problems and other anomalies from ETM tests.

For Increment 3, the developer has adopted an evolutionary software development plan that phases in ground software between CY06 and CY10, in pace with the population of the SBIRS Low constellation. Full constellation capability will not be delivered until approximately half of the constellation is on-orbit, at which point the IOT&E will be conducted. To ensure that full functionality will be available when needed, DOT&E will require a demonstration of stable, supportable, functional ground and space software prior to first flight to support the first six satellites, and that full software functionality be available and tested within the one-year launch hiatus.

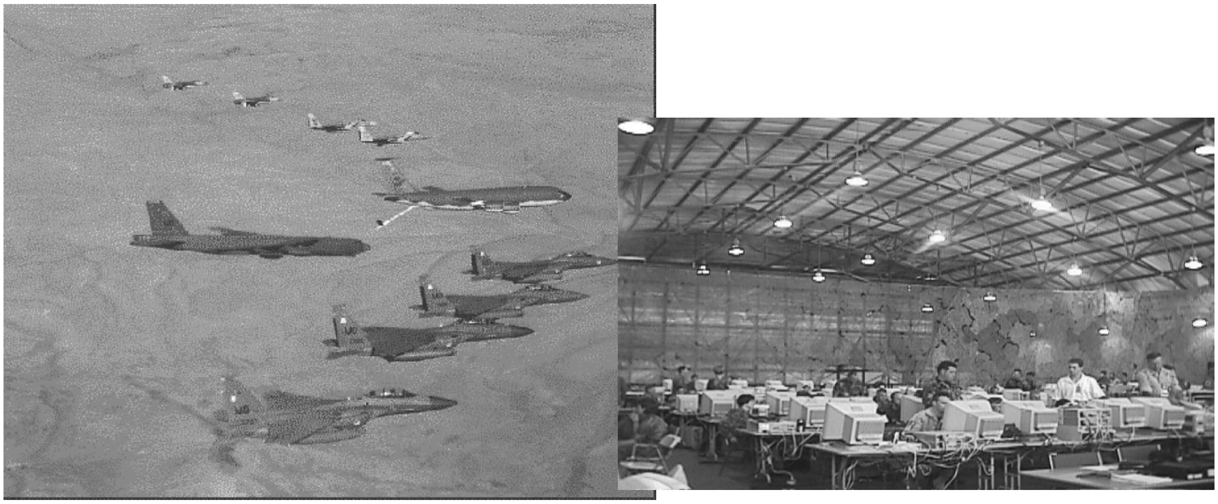
RECOMMENDATIONS

- Incorporate scene and target projection into SBIRS High payload performance tests.

- Develop risk mitigation plans should the MCSB construction or Increment 2 software be delayed.

- For SBIRS Low satellites, provide for full software functionality to be available and tested within the one-year launch hiatus.

THEATER BATTLE MANAGEMENT CORE SYSTEM (TBMCS)



Joint ACAT I AC Program (Air Force Lead)		**Prime Contractor**
Total Number of Systems:	29	Integration – Lockheed Martin
Total Program Cost (TY$):	$1.6B	
Full-rate production:	4QFY00	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Theater Battle Management Core Systems (TBMCS) provides hardware, software, and communications interfaces to support the preparation, modification, and dissemination of the Force Level theater and Air Component Air Battle Plan (ABP). The ABP includes the Air Tasking Order and Airspace Coordination Order. The TBMCS unit level provides Air Force Wings and Bases the capability to receive the ABP, parse it, and manage wing operations to support execution of the ABP or modifications to it.

TBMCS supports the development and sharing of a ***common relevant operational picture*** of theater air and surface activity. TBMCS common applications and interfaces provide a robust network for **Joint and Multinational Force** data sharing. The TBMCS intelligence and targeting applications at the theater Joint Force Air Component Commander level and at the Air Support Operations Center and Direct Air Support Center levels support the coordination of Forward Edge of the Battle Area to deep or long-range ***precision engagement*** fires, safe passage zones, and near real-time warnings of impending air attack contributing to ***full-dimensional protection***. The air and surface surveillance and weapons coordination engagement options provided by TBMCS implementation enables ***synchronized operations*** and employment of the ***correct weapons*** for each target to generate the desired results. All TBMCS network participants contributing to improved decision making by the Battle Commanders share engagement intentions and results assessments. The TBMCS system used by all the Services share common components, including software applications, providing a significantly improved level of ***sustainment interoperability***.

The TBMCS includes workstations, servers, routers, communications links, and applications software. TBMCS Version 1.0.1 comprises five Key Legacy Functions (KLFs) viewed as the minimum operational capability needed to replace the Contingency Theater Automated Planning System (CTAPS), Combat Intelligence System (CIS), and the Wing Command and Control System (WCCS). TBMCS Version 1.0.1 also includes a number of non-KLF functions and capabilities. The five KLFs are: (1) nominate and prioritize targets; (2) plan and disseminate the ABP; (3) receive and parse the ABP; (4) plan a detailed flying schedule within 4 hours of receiving the ABP; and (5) monitor and control execution of the ABP.

TBMCS versions beyond Version 1 will provide additional or improved hardware and software capabilities to improve real-time targeting, accuracy of targeting, data handling and dissemination, and interoperability with national intelligence data bases.

Planned TBMCS fielding includes every theater air component, all Navy aircraft carriers and command ships, all Marine Air Wings, and all Air Force flying wings and ASOC squadrons. Army Battlefield Coordination Detachments will also employ TBMCS.

BACKGROUND INFORMATION

The TBMCS has been in development since 1994. In October 1999, TBMCS was placed on the OSD T&E Oversight List and AFOTEC became the lead test organization.

The Air Force does not have an approved Mission Need Statement or an Operational Requirements Document (ORD) for TBMCS. Instead TBMCS development is driven by a Statement of Need and ORDs for the legacy systems, and a draft Systems Version Requirements Document further scoped by a Customized User Agreement. Requirements have been drawn from these documents to identify TBMCS Version 1 “legacy” test requirements. OSD is coordinating the establishment of an OSD Overarching Integrated Process Team to support future TBMCS development and acquisition in accordance with DOD 5000.2.

TEST & EVALUATION ACTIVITY

The first TBMCS Multi-Service Operational Test and Evaluation (MOT&E) (MOT&E I), conducted in January 2000, was halted early due to data base contention and integrity problems. The developer addressed the software problems and along with the Air Force user, developed a Concept of Employment that provides guidance on how to minimize resource contention with the data base. Following several Government In-plant Tests and a Field Developmental Test, a second MOT&E (MOT&E II) was conducted from July 24-31, 2000, to determine the effectiveness and suitability of the baseline TBMCS software in satisfying legacy KLFs. Both MOT&Es included the distributed participation of five Air Force TBMCS main nodes, two Marine nodes, two Navy nodes (including one ship), and the Army participating from both the USAF and Navy nodes. MOT&E I included an Information Assurance vulnerability evaluation using external and internal penetration techniques.

The AFOTEC MOT&E Test Plan, which supported the TBMCS MOT&E I, was conditionally approved by DOT&E in January 2000, with follow-on test requirements cited. DOT&E approved an update to that plan for MOT&E II in July 2000. The TBMCS TEMP was also approved in July 2000, but the approval memorandum noted that programmatic deficiencies need to be satisfied and a TEMP update submitted to cover future TBMCS development.

TEST & EVALUATION ASSESSMENT

The TBMCS MOT&E conducted in January 2000 demonstrated that TBMCS was unable to support sustained development and management of the ABP in a simulated operational environment. While more than 500 deficiency reports were submitted during this MOT&E, the primary problems were timely dissemination of the ABP to other TBMCS nodes, data base contention access, and data integrity. When a number of operators operated TBMCS applications that accessed the intelligence and targeting data bases, the automated features of TBMCS slowed and sometimes stopped requiring lengthy restart procedures. Also, when Air Tasking Orders were exchanged between TBMCS servers, missions and mission data would be missing at the receiving location.

Preliminary analyses from the July 2000 MOT&E II indicate that TBMCS 1.0.1 can be effective in providing Key Legacy Functionality when employed by highly trained operators equipped with adequate computer hardware, but significant shortfalls exist in operational suitability. In several non-KLF areas, TBMCS 1.0.1 does not appear to be operationally effective or suitable. During MOT&E II, Air Battle Plan production and execution at all Force and Unit levels were adequately accomplished. Transmission of the Air Battle Plan was accomplished within stated time requirements in four out of seven opportunities, with communications problems being a significant factor in two of the late transmittals. Performance of the IRIS message handling system at the Navy node was much slower than the IRIS system at the Air Force node (a 100 Mhz vice a 600 Mhz computer server), and when communications outages were experienced, performance deteriorated further and led to lost or delayed messages containing airlift information and Army Air Support Requests. Operationally, at best this would require additional action to discover the missing Air Support Requests in order to re-enter them; in the worst case, since TBMCS does not alert the sender that messages have not been received, ground forces may not receive needed air support. The TBMCS system, along with interfacing systems, should be sufficiently robust and persistent to give the user confidence of message delivery and notification when a message has not been received within reasonable time.

Employment of TBMCS 1.0.1 requires many workarounds and a high degree of training, but offers a number of improvements in the planning and execution of theater air operations over the currently fielded CTAPS, WCCS, and CIS. Interviews with users familiar with the legacy systems generally indicate a strong preference for TBMCS. However, based on MOT&E II results, TBMCS does not yet provide core functionality, that minimum set of capabilities that permit the user to effectively accomplish his mission in the operational environment, including sufficient levels of interoperability, supportability, and training adequacy, such that the user would be satisfied if no additional capability were ever delivered.

Once corrective actions to identified shortfalls have been implemented and verified in a follow-on test of appropriate scope, the operational effectiveness and suitability of TBMCS should be re-assessed. DOT&E will remain involved with the TBMCS Program as the path ahead is developed and associated T&E plans are made.

TRANSCOM REGULATING AND COMMAND & CONTROL EVACUATION SYSTEM (TRAC²ES)

Air Force ACAT IAM Program

Total Number of Systems:	1
Total Program Cost (TY$):	$163M
Average Unit Cost (TY$):	$163M
Initial Operating Capability:	3QFY01

Prime Contractor

Booz, Allen & Hamilton

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The TRANSCOM Regulating and Command & Control Evaluation System (TRAC²ES) is an Automated Information System (AIS) that combines transportation, logistics, and clinical decision elements into a seamless patient movement automated information system. It will be capable of visualizing, assessing, and prioritizing patient movement requirements, assigning proper resources, and distributing relevant data to deliver patients efficiently. The system automates the processes of medical regulation (assignment of patients to suitable medical treatment facilities) and aeromedical evacuation during peace, war, and contingency operations. TRAC²ES will automate Global/Theater Patient Movement Requirements Center (GPMRC/TPMRC) operations at Headquarters, United States Transportation Command (USTRANSCOM); Headquarters, United States European Command; and Headquarters, United States Pacific Command. TRAC²ES will also provide deployable Patient Movement Requirements Center capabilities to support CINC or JTF requirements. It will replace two existing legacy systems: the Defense Medical Regulating Information System and the Automated Patient Evacuation System. Neither of these systems can be economically modified to integrate with the Global Transportation Network (GTN) (DoD's transportation AIS) and the Theater Medical Information Program (DoD's deployable medical AIS). TRAC²ES supports the ***Joint Vision 2020*** concept of ***focused logistics*** by fusing information, logistics, and transportation technologies to provide rapid medical regulation and patient evacuation during crisis situations. It enables a deployed force to be more efficient in protecting lives.

BACKGROUND INFORMATION

TRAC^{2}ES was originally planned to be a module of GTN. However, in late 1996 DoD decided to develop TRAC^{2}ES as a separate system. Functional and technical responsibilities were assigned to the USTRANSCOM Surgeon General, with input from the Assistant Secretary of Defense (Health Affairs). In August 1997, technical program responsibility was transferred to the Air Force and AFOTEC was assigned as the independent OTA. In July 1998, TRAC^{2}ES was granted Milestone I/II, which included the authority to award a development contract to Booz, Allen & Hamilton of McLean, VA. Subsequent cuts in funding have significantly delayed the program and virtually curtailed development after the IOC version is fielded in 2001.

TEST & EVALUATION ACTIVITY

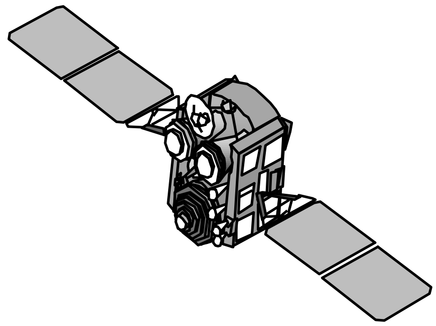
The TEMP, which had been in final draft, is being re-worked to incorporate the latest acquisition strategy, and is expected to be submitted to OSD for approval soon. Working closely with USTRANSCOM and other user representatives, AFOTEC developed mission-level requirements that can be tested comprehensively during independent IOT&E. With DOT&E endorsement, AFOTEC developed a Combined Test Force (CTF) concept to integrate OT&E into the early stages of the acquisition process. As part of this process, IOT&E will be preceded by an Operational Field Test (a type of OA) in October 2000. The CTF process allows early deficiency identification and resolution, and facilitates incremental refinement prior to IOC.

AFOTEC has developed a draft IOT&E plan, and is prepared to begin independent IOT&E as soon as the system is ready. Dedicated IOT&E will focus on two major evaluation areas. The first area is Rapid Evacuation of Patients from Theater. AFOTEC will address this focus area during a 1-week command post exercise held in the Continental United States (CONUS). The second major evaluation area is Efficiency of Global Patient Movement Operations. AFOTEC will address this area by direct observation of TRAC^{2}ES support of daily patient movement at the GPMRC at Scott AFB, IL; at the TPMRC at Ramstein AFB, Germany; and at several military medical treatment facilities throughout CONUS and Europe. Test activity is currently scheduled at these locations over a 6-week period beginning in January 2001.

TEST & EVALUATION ASSESSMENT

Since TRAC^{2}ES is both a medical and a transportation system, the operational testers will need to be qualified in both fields. The system must meet the needs of the transporters, the medical providers at both ends, and most importantly the patients. The testers will have to deal with the technical challenges inherent in a new system with numerous interfaces, as well as the operational challenges of a system that crosses different disciplines. It has been a challenge to refine mission-level requirements that consider the needs of all users, including the USTRANSCOM proponent and the warfighting Commanders-in-Chief. DOT&E has worked closely with the medical and transportation functional communities, AFOTEC, and the TRAC^{2}ES Program Management Office to address these issues in order to develop a comprehensive and effective test and evaluation plan.

WIDEBAND GAPFILLER SATELLITE (WGS)



Air Force ACAT ID Program		**Prime Contractor**
Total Number of Systems:	3	TBD
Total Program Cost (TY$):	$900M	
Average Unit Cost (TY$):	$300M	
Full-rate production:	N/A	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Wideband Gapfiller Satellite (WGS) communications system provides communications to U.S. warfighters, Allies, and Coalition Partners during all levels of conflict short of nuclear war. It is the wideband component for the transition to the DoD's future Military Satellite Communications architecture. WGS will provide the warfighter with the ***information superiority*** necessary to act inside the decision cycle of the adversary, and execute ***precision engagement*** as the ***dominant maneuver force*** during activities leading up to and during armed conflict.

WGS will satisfy military communications needs by providing communications in both the X-band and military Ka-band frequencies. It will combine capabilities onto a single satellite for tactical X-band communications, augment the Global Broadcast Service (GBS) Phase II system, and provide new two-way Ka-band services. This new service is being introduced to alleviate the spectrum saturation of X-band, and will greatly increase both the available single-user data rate and total satellite capacity over today's Defense Satellite Communications System (DSCS) III satellites.

WGS will provide essential communications service for the Commanders in Chief to command and control their tactical forces in military operations short of nuclear war. Wideband Gapfiller provides connectivity with the terrestrial portion of the Defense Information Services Network, the Army Command and Control System, Marine Air Ground Task Force networks, Air Force wideband networks for Air Expeditionary Forces, and other intelligence data dissemination communications systems. WGS also provides high capacity communications links to support the Warfighter Information Network communications equipment nodes used to disseminate imagery and targeting update information.

BACKGROUND INFORMATION

WGS will join four X-band DSCS III/Service Life Extension Program satellites and three Ka-band UFO/GBS Phase II satellites in the DoD wideband constellation. Each geosyncronous Gapfiller satellite will operate in both X-band and military Ka-band. The Ka-band services will augment broadcast service provided by GBS payloads on UHF Follow-On (UFO) satellites and support two-way network services. The satellites will also support cross-banded service connectivity: X-band uplinks to Ka-band downlinks and Ka-band uplinks to X-band downlinks. All such design characteristics are notional at this writing; design specifics will be determined following completion of cost/performance trade-offs and finalization of scenario-driven requirements.

The program will be acquired under the Federal Acquisition Regulation Part 12 rules for commercial item acquisition. Because of its commercial nature, this program has no lead-in development phase, but will proceed directly from award to launch in one combined EMD/Production phase. The development schedule is three years, with first launch in 1QFY04. The final two launches are planned for 1Q and 3QFY05.

The 2001 Defense Appropriations Act signed on August 9, 2000, limited funding to two satellites. Subsequently, the Office of the Secretary of Defense signed a Program Decision Memorandum on August 22, 2000, supplementing WGS funding by $272.9 million to ensure system success. The WGS acquisition, as identified in the WGS System Operational Requirements Document (ORD) and per the Senior Warfighters Forum recommendation, will acquire three satellites.

TEST & EVALUATION ACTIVITY

The four major test activities will be: (1) an EOA conducted before the Milestone II/III decision; (2) an OA conducted during the Critical Design Review timeframe; (3) combined DT/OT testing conducted before Multi-Service Operational Test and Evaluation (MOT&E); and (4) MOT&E conducted prior to IOC.

MOT&E will include participation from the Air Force, (including the Air Force Information Warfare Center (AFIWC)), Army, Navy, Marines, and the Joint Interoperability Test Center (JITC). The Joint Spectrum Center will assist the OTAs in evaluating electromagnetic environmental effects. AFOTEC is the lead service OTA and will provide a test director. JITC, in concert with the OTAs, will perform Joint interoperability testing and provide the necessary interoperability certification. AFIWC will assist the OTAs in evaluating information assurance. The ORD and the WGS Concepts of Operation will be the primary sources of requirements. MOT&E will be conducted at various locations covering the numerous system C2 nodes, and will support the IOC declaration.

TEST & EVALUATION ASSESSMENT

AFOTEC conducted an EOA of the Wideband Gapfiller Satellite system to support a combined Milestone II/III decision. Data collected during the scope/cost process contributed to the development of this assessment.

The complexity of cross-banding between the X-band and Ka-band on board the satellite, and the concurrent development of the Gapfiller Satellite Configuration Control Element (GSCCE) with the automation upgrades of the Satellite Operations Center and Defense Satellite Communications System

(DSCS) Operations Center (DSCSOC) networks, pose a risk to successful WGS development and implementation.

Interoperability requirements compound the complexity of developing the control software for WGS. The GSCCE used to control WGS payloads must be interoperable with the Defense Satellite Communications System Operations Center network. A software development program is ongoing which will upgrade the DSCSOC network to a new ODOCS system; this is separate from the concurrent program that will produce the GSCCE. If the GSCCE and the ODOCS are not interoperable, the DSCSOC operators will not be able to successfully establish communication networks with operational users.

Additionally, the Wideband Gapfiller Satellite and the Global Broadcast System must be interoperable. GBS has a separate support infrastructure to control the payloads on the UFO satellites and for structuring broadcasts to users in the field. WGS payloads (to include Ka-band) are proposed to be controlled by the DSCSOC's, currently only capable of controlling X-band payloads. Interoperability between these two systems must be synergistic and not compete to ensure high-speed access for broadcast users.

PART VI

OTHER DEFENSE PROGRAMS

MEDIUM EXTENDED AIR DEFENSE SYSTEM (MEADS)

Army ACAT IC Program

Total Number of Systems:	TBD
Total Program Cost (TY$):	TBD
Average Unit Cost (TY$):	TBD
Milestone B:	FY04
Milestone C:	FY09
FUE:	FY12

Prime Contractor

MEADS International (Lockheed Martin, Daimler Chrysler Aerospace and Alenia)

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Medium Extended Air Defense System (MEADS) will be a highly mobile, low to medium altitude air defense system designed to ensure protection of maneuver forces. It will be a key element of the theater missile defense in the Army Air and Missile Defense architecture. The system will provide area and point defense capabilities against multiple, simultaneous, 360˚ attacks by ballistic missiles and rockets, air-to-surface missiles, cruise missiles, and aircraft. These threats may employ conventional and/or weapons of mass destruction warheads.

A MEADS battle element will consist of 360˚ surveillance and fire control radars, launchers. missiles, and Tactical Operations Centers (TOC). MEADS will be capable of deployment as a single battle element or as a battalion operating from geographically displaced locations. All system components will be employed in a distributed architecture using high-capacity tactical communications. Netted and distributed sensors will provide continuous, redundant, and optimized target tracking. TOCs can control launchers from other battle elements if tactical circumstances require it. As part of the Army

Air and Missile Defense Architecture, the system will be compatible and interoperable with other Army, Joint Service, and allied systems expected to participate in joint/combined operations in the 21st century.

The MEADS system is a response to ensure protection of maneuver forces. The system will provide area and point defense capabilities against tactical missiles and air breathing threats. MEADS will contribute to three of the four ***Joint Vision 2020*** operational concepts: ***precision engagement***, ***full-dimensional protection,*** and ***dominant maneuver*** forces. MEADS incorporates state-of-the-art technologies in its sensors, weapons, and BM/C^4I systems. ***Information superiority*** will enable MEADS to be fully capable of operating autonomously or in a network, receiving and exchanging data with other theater air and missile defense systems and external sensors. The MEADS system will help ensure that Joint Forces enjoy ***full-spectrum dominance*** in the theater by being a primary contributor to ***full-dimensional protection*** of the ***dominant maneuver*** forces through ***precision engagement*** of threat tactical missiles and air breathing threats.

BACKGROUND INFORMATION

The MEADS program was scheduled to transition to the Design and Development Phase in FY99. However, given competing priorities for U.S. Ballistic Missile Defense resources, the U.S. proposed a restructured MEADS program to include a three-year Risk-Reduction Effort. This restructured program is based on the PAC-3 missile. Germany and Italy have accepted the PAC-3 missile as the initial interceptor for MEADS. The U.S. has fully funded the MEADS program by adding $721M from FY02-FY05, and the program schedule supports the first MEADS flight test in FY06 and a U.S. First Unit Equipped (FUE) in FY12. The Army modernization plan for MEADS initially replaces four PATRIOT battalions with MEADS battalions by FY15, and eventually replaces all PATRIOT battalions with MEADS battalions.

On November 15, 1999, the NATO MEADS Management Agency (NAMEADSMA) awarded a contract to MEADS International [a partnership between Lockheed Martin, Daimler Chrysler Aerospace AG (now European Aeronautic Defence and Space Company), and Alenia Marconi Systems] to begin work on the next phase of the program. This effort supported the transition of MEADS into the Risk-Reduction Effort. The three-year Risk-Reduction Effort contract is expected to be awarded to MEADS International in early FY01.

The proposed program management structure includes both U.S. and international arrangements. U.S. oversight is planned to be accomplished through the Integrated Product Team (IPT) process. The Army's MEADS National Product Office oversees U.S. requirements development and serves as the single point of contact for U.S. support to NAMEADSMA. International oversight is accomplished through the National Armaments Directors and a MEADS Steering Committee. The Army PEO for Air and Missile Defense represents the United States on the Steering Committee. Leadership positions of NAMEADSMA will rotate among the nations.

The MEADS acquisition concept will tailor new DoD 5000.2 guidance with the NATO acquisition process. Since NATO defers most risk-reduction activity to the Design and Development Phase, the program will be reviewed at the following key acquisition points:

- The end of Program Definition/Validation and Risk-Reduction phases (the Milestone B D&D decision).

- After the Critical Design Review (a Milestone II-like system development decision).

- Before starting Low Rate Initial Production (LRIP) (the Milestone C LRIP decision).

- Two years into the NATO production phase (a Milestone III-like decision).

Program documentation at each decision point will match what would normally be available for U.S. milestone decisions.

TEST & EVALUATION ACTIVITY

Several T&E IPTs were held during this reporting period to begin planning the test program. Now that the program has been restructured to incorporate the PAC-3 interceptor, the T&E IPT needs to develop a T&E strategy that builds on the testing conducted as part of the PAC-3 program. A U.S Lethality Working Group will be formed to develop a U.S. LFT&E Strategy. A NAMEADSMA Lethality Working Group will also address lethality issues of concern to the international partners. T&E activity is currently on hold pending the signing of the international contract, but contractor testing will begin during RRE and lead up to an RRE Exit Demonstration where prototype MEADS elements will detect and track fixed-wing targets, generate missile-fire solutions, and conduct virtual intercepts.

TEST & EVALUATION ASSESSMENT

The sponsoring countries have together developed the MEADS system international-operational requirements. According to the requirements, the MEADS system must provide area and point defense capabilities against a variety of tactical-missile and air-breathing threats. The MEADS mission is complicated by having to accomplish its mission in a maneuver area that can be densely populated with both friendly forces and threat targets. The system development risks and challenges that exist for all other missile defense systems also exist for MEADS. The MEADS system must acquire, track, and identify both friendly and threat targets, fuse the data, and then effectively engage and kill the threat targets. The difficulty and risk associated with MEADS development is high, and includes issues with the following major end items:

- ***X-Band Fire Control Radar***: Producibility of high power and high-efficiency transmit/receive modules; thermal performance; performance of a low noise exciter; jamming and clutter cancellation; classification, discrimination, and identification in ECM and/or clutter environments; and operation while rotating 360 degrees.

- ***BM/C^{4}I*:** Development of the netted and distributed architecture; sensor management and track fusion for multiple radars (both X-band fire control and UHF surveillance); and incorporation of external cues.

- ***PAC-3 Missile***: Demonstration of hit probability against the MEADS target set in stressing environments; demonstration of lethality against the MEADS target set; integration of the PAC-3 missile into the MEADS system (including potential modifications to add X-band communications).

Due to the requirement to effectively kill multiple types of targets, the T&E program will be complex, difficult, and costly compared to other Theater Missile Defense (TMD) systems. Its LFT&E program will need to address lethality against a broader target set and a more diverse intercept space than those of other TMD systems. The flight-test matrix is being restructured to make use of PAC-3 missile testing, but some PAC-3 capabilities are being deferred until after the PAC-3 Milestone III Decision; PAC-3 follow-on testing is still undefined. During FY01, we will develop a MEADS test program that includes a balanced mix of testing supported by modeling and simulation. We will coordinate with the U.S. National Product Office to plan a thorough T&E program for MEADS that satisfies U.S. T&E requirements and meets the needs of the partner nations.

NATIONAL MISSILE DEFENSE (NMD)

DoD ACAT ID Program		**Prime Contractor**
Total Number of Interceptors:	100 (capability expanded)	LSI, Boeing North American
Total Life-Cycle Cost (TY$)	Cumulative Cost	
Capability 1 (Expanded):	$29,500M*	
Capability 2:	$35,600M*	
Capability 3:	$48,800M*	
Interceptor Cost (TY$):	$18M	
Deployment Readiness Review:	August 3, 2000	
Capability 1 IOC (program of record)	FY05	

*Assumes an FY05 Initial Operational Capability. These figures are Congressional Budget estimates taken from: *Budgetary and Technical Implications of the Administration's Plan for National Missile Defense, April 2000.*

NOTE: As of the date of preparation of this report, the NMD program is undergoing a revision in acquisition planning and testing strategy. While this may invalidate some of the verbiage herein, the discussions of test results, testing adequacy and limitations, and technological challenges are still relevant.

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The mission of the National Missile Defense (NMD) system is to defend all fifty United States against a limited strike of Intercontinental Ballistic Missiles (ICBMs). The initial deployment (Capability 1 (C1)) is intended to satisfy the threshold operational requirements and defend against limited attacks by adversaries from "States of Concern" (formerly known as "Rogue Nations) with a residual capability against small-scale unauthorized or accidental launches by the major declared nuclear powers. C1 will deal with a defined set of simple countermeasures and field 20 interceptors. C1-Expanded will be fielded two years later and will add 80 more interceptors for a total of 100 and upgrade the X-Band tracking radar. The NMD system is intended to perform surveillance, detection, tracking, discrimination, and battle management functions, including engagement planning, intercept, and kill assessment, which requires the integration of multiple sensor, communications, command and control, and Ground Based Interceptor elements. Capability 2 will be an upgraded configuration that is intended to cope with more complex countermeasures. Capability 3 would meet the objective values of the User's operational requirements and result in a total fielding of 250 interceptors and add additional launch sites. The objective capability may take an additional five years after the initial deployment of NMD to become fully operational.

The NMD system is an integrated collection of core "elements" consisting of the Battle Management, Command, Control, and Communications (BMC^3) element, Upgraded Early Warning Radars (UEWRs) and an X-Band Radar (XBR), and an arsenal of Ground Based Interceptors (GBI). The system will also be supported by external space-based sensors (the Defense Support Program and Space Based Infrared System satellites). The BMC^3 at the Cheyenne Mountain Operations Center will perform engagement planning and situation assessment while keeping a "human-in-control" and serves to integrate GBI and sensor operations. The GBI is a silo-based, three-stage, ICBM-class missile that delivers a separating Exoatmospheric Kill Vehicle (EKV) to a "deployment basket" above the atmosphere en route to engage a threat Re-entry Vehicle (RV). The EKV employs visible and infrared sensors to acquire and track the target, performs onboard discrimination to select the RV from associated objects, and fires divert thrusters to steer itself to achieve a direct hit on the targeted RV. After the intercept, ground radars continue to collect data on the engagement so that a kill assessment can be made.

By design, NMD embodies the ***Joint Vision 2020*** operational concept of ***precision engagement***: NMD is an integrated system of sub-system elements that relies on ***information superiority*** to provide responsive command and control to engage attacking ICBMs. It performs kill assessment to evaluate the success of an engagement, and is capable of executing multiple engagements. By providing defense for the nation, NMD also incorporates the operational concept of ***full-dimensional protection***.

BACKGROUND INFORMATION

In early 1996, DoD completed a comprehensive review of its theater and national ballistic missile defense programs. The review shifted the NMD program from a Technology Readiness Program (1993-1996) to a Deployment Readiness Program (1996-2003), with the potential for a deployment decision in 2000. The acquisition strategy for NMD was referred to as the "3+3" program.

In spring 1998, the Ballistic Missile Defense Organization awarded the Lead System Integrator (LSI) contract to Boeing North American. The LSI serves as the prime contractor for NMD system development. The LSI contractor will be responsible for integrating the elements of NMD (sensors, interceptors, and the BMC^3) and for demonstrating system capability through integrated ground and flight testing. In December 1998, the LSI selected Raytheon over Boeing as the EKV contractor.

In January 1999, the Secretary of Defense redirected the acquisition of the NMD program to implement a phased deployment approach, based upon technical progress, leading to an operational system by the end of FY05. The revised strategy retained a 4QFY00 Presidential deployment decision based, in part, on the demonstrated technological feasibility of the system to defeat the C1 threat. Prior to this decision, a senior-level DoD Deployment Readiness Review (DRR) would be the basis for a SECDEF recommendation to the President regarding initial steps toward an FY05 deployment of a C1 NMD system, with an option to deploy C1-Expanded by FY07. That DRR would assess the satisfaction of seven deployment readiness decision criteria approved in June 1999 by the Under Secretary of Defense for Acquisition, Technology and Logistics.

The DRR was conducted on August 3, 2000. The specific decisions addressed at the DRR were element site selection, the authorization to award site-construction contracts, and the purchase of long-lead XBR hardware. Two subsequent decision points had also been added on the path to the 2005 deployment. An FY01 decision would consider the building and/or upgrading of required ground radar systems, the integration of command and control software into the Cheyenne Mountain Operations Center, and the purchase of long-lead interceptor hardware. Due to a slip in the testing of the tactical booster, the long-lead interceptor hardware decision cannot be looked at until FY02. An FY03 decision was to determine if the GBI is ready for limited production and deployment. The program is currently being re-baselined and several different options are being considered. As a result, the program planning and acquisition decision milestones may be changed.

On September 1, 2000, the President announced that, based on the information available to him, he could not conclude that there was enough confidence in the technology and operational effectiveness of the entire NMD system to move forward to deployment. He also asked the Secretary of Defense to continue a robust program of development and testing.

TEST & EVALUATION ACTIVITY

The NMD T&E program aims to incrementally demonstrate progress toward C1 capability through integrated ground testing, integrated (intercept) flight testing, risk-reduction flights, digital simulations, and human-in-the-loop command and control exercises. Integrated Flight Tests (IFTs) and Risk-Reduction Flights (RRFs) are conducted between Vandenberg Air Force Base (VAFB) in California and Kwajalein Missile Range (KMR) in the Marshall Islands. Integrated Ground Tests (IGTs) continue to be conducted at the Integrated System Test Capability (ISTC) facility in Huntsville, AL. Battle Planning Exercises and Command and Control Simulations leverage the Joint National Test Facility in Colorado Springs, CO. Additionally, lethality testing is performed at the Arnold Engineering Developmental Center in Tennessee, and the results are combined with those obtained using physics-based hydrocode computer simulations created and conducted by Department of Energy laboratories.

As laid out in the pre-DRR (Phase I) TEMP, which was approved by OSD in December 1999, testing in FY00 focused on the acquisition of data to support the assessment of the deployment readiness criteria as well as on continued system development. This TEMP is in the process of being updated. The post-DRR (Phase II) TEMP will lay out the T&E program from the present to IOC (2005 according to the program of record, but in the process of probable revision) and will provide a detailed T&E roadmap, to include modeling and simulation, for the development of a C1 NMD system. The Phase II document is expected at OSD in 2QFY01.

The flight test program has demonstrated a very basic functionality of a system of NMD surrogates and prototypes. The configuration of the NMD system during the two integrated system flight tests to date (IFT-4 and IFT-5) was, and will remain to be for some time, a limited functional representation of the objective system. Initially using surrogates to approximate NMD elements (as needed), then progressing to prototypes, IFTs are designed to demonstrate potential overall system effectiveness, collect data that address system issues and key technical parameters, and verify the performance of NMD elements. The following table summarizes integrated flight test results executed to date.

Integrated Flight Tests Executed to Date

EVENT	DATE	OBJECTIVES/RESULTS
IFT-1A	June 24, 1997	Non-intercept flight test (fly-by) to assess the performance of the Boeing-built EKV seeker, collect target phenomenological data, and evaluate (post-test) target-modeling and discrimination algorithms. **Test objective achieved – Boeing was not chosen as the NMD EKV contractor**.
IFT-2	January 16, 1998	Non-intercept flight test (fly-by) to assess the performance of the Raytheon-built EKV seeker, collect target phenomenological data, and evaluate (post-test) target-modeling and discrimination algorithms. **Test objectives achieved – Raytheon was chosen as the NMD EKV contractor**.
IFT-3	October 2, 1999	First intercept attempt of a target RV by the Raytheon-built EKV. IFT-3 was an element test of the EKV, not an end-to-end system test, which relied upon a surrogate booster vehicle and range assets to define the "deployment basket" and deliver the EKV to that location. Once deployed, the EKV operated autonomously to intercept the mock RV. BMC^3 and other elements functioned as planned in a background ("on-line") test in parallel with the EKV flight test. **Intercept achieved**.
IFT-4	January 18, 2000	First end-to-end system test (intercept attempt) using NMD prototype elements (except the IFICS) and range assets to approximate the objective system. The EKV was again successfully delivered by a surrogate booster and separated into the "deployment basket." **Although IFT-4 demonstrated the successful operation and integration of NMD elements, an intercept was not achieved**. The failure is directly traceable to the cryogenic cooling system of the EKV, which failed to cool the IR sensors down to their operating temperatures in time because of an obstructed cooling line.
IFT-5	July 8, 2000	Second end-to-end system test (intercept attempt) using NMD prototype elements and range assets to approximate the objective system. A new feature of the test, as compared to IFT-4, was the participation of the IFICS as the communication link between the BMC^3 and EKV. **Although IFT-5 demonstrated the successful operation and integration of the BMC^3 and ground-based radars, an intercept was not achieved**. The failure is the direct result of the EKV not separating from the surrogate booster due to an apparent failure in a 1553 data bus in the booster. No EKV test objectives were met.

In addition to intercept flight tests that the NMD program plans, manages and executes, the NMD Joint Program Office (JPO) and Boeing leverage a series of Risk-Reduction Flights (RRFs). The majority of RRFs are conducted as associated operations with Minuteman III and Peacekeeper Force Development missions. NMD additions to the planned tests are structured to meet IFT risk reduction requirements. There are no interceptors flown during RRFs. The RRFs provide a flight test environment by which each element, in a system configuration context, examines integration with other elements and interoperability with external systems. The RRFs provide a vehicle for testing IFT setups, provide test team training, verify up-range and downrange element integration prior to the IFT, and verify the real-time test procedures. A total of ten RRFs have been flown to date, the last three in FY00. In addition to reducing risk for upcoming IFTs, RRFs are being used to investigate discrimination and countermeasure issues. RRF-9, for example, deployed a total of 22 objects, including an RV, replicas, balloons, and other countermeasures. RRFs typically fly trajectories similar to IFTs, however, some are flown parallel to the California coastline to examine potential UEWR performance in a crossing trajectory.

Computer modeling and simulation will be employed to efficiently repeat hypothetical experiments in order to determine, with statistical confidence, the values of technical performance measures throughout the engagement envelope. Further, digital simulations provide representations of elements that are not mature enough for the flight test program. The principal simulation tool providing system-level evaluation is the LSI Integration Distributed Simulation (LIDS). Late delivery of LIDS Build 4 precluded its use for making a credible assessment of potential NMD system performance in support of the DRR.

Integrated ground tests performed at the ISTC use a combination of models, software-in-the-loop, and hardware-in-the-loop components to test the NMD system to the extent possible in a simulated operational environment. They are intended to validate system functionality and integration between NMD elements, subject the system to stressing environments and operational scenarios, and evaluate tactical intercept boundary conditions. The only IGT conducted in FY00 was IGT-5, a series of runs that were performed during October 19-29, 1999. IGT-5 demonstrated the successful integration of the BMC^3, GBR-P/XBR, and UEWR simulations, but the capability to demonstrate the integration of the simulated BMC^3 with the GBI was not yet available. That function will not be tried until IGT-6. IGT-5 provided a very limited assessment of NMD performance against a sub-set of C1 requirements. Future IGTs will include improvements to the NMD element representations. The LSI is planning on conducting IGT-6 in 2QFY01.

In 2000, NMD continued tests and analyses to develop and accredit the lethality simulations (Parametric Exo-Endoatmospheric Lethality Simulation (PEELS) and hydrocodes) that will be used to evaluate NMD system effectiveness. Activity included twenty 1/4-scale Light Gas Gun data shots against Medium Sized Re-entry Vehicle targets and a number of other tests at Sandia National Laboratories to develop Equations Of State for RV materials.

On April 4, 2000, PEELS 8.1 was accredited by the Accreditation Working Group for the determination of the following system evaluation parameters:

- RV negation.
- Probability of Kill Single Shot.
- Probability of Hitting Target Within Defined Aim Point Accuracy.

- Probability of the NMD System Meeting its Objective.

- Determination of aim point selection to support DRR.

The LFT&E Working Group, a subgroup of the NMD Lethality IPT, is in the process of modifying the LFT&E strategy for NMD, as currently presented. LFT&E activities are expected to include integrated flight testing, quarter-scale light-gas-gun impact testing, and hydrocode simulation analyses. The integrated flight test program is currently scheduled to conduct three LFT&E flight tests, flying targets with representative "threat packages," for lethality assessment.

TEST & EVALUATION ASSESSMENT

Due to its late delivery, immaturity, and lack of validation, the LIDS high fidelity system-level model has not yet been used to make any significant assessment at this time. LIDS Build 4 has been delivered to the OTAs for training and DOT&E will participate in that training.

The IGTs conducted to date are by design being conducted using current configurations of element hardware and software and do not have all of the planned functionality of the C1 design. This has precluded a true assessment of the potential operational effectiveness of the system that is planned for deployment. Of the seven different scenarios examined in IGT-5, only one scenario had nominal performance. Boeing attributed the off-nominal performance in the other scenarios to a lack of maturity of the NMD element representations used in IGT-5. None of the scenarios in IGT-5 were completely operationally realistic. For example, only one IGT scenario to date, by design, featured any countermeasures at all, and those were limited to unsophisticated countermeasures. Additionally, the simulated NMD system in IGT-5 could not process more than about two dozen objects in any one scenario, so much of the target debris was removed from many of the IGT-5 scenarios (in one particular scenario, almost 90 percent of the target objects was removed). The lack of these objects made these thinned scenarios unrealistic for testing discrimination, radar resource management, and BMC^3 processing capabilities.

The flight test program has demonstrated, as indicated above, the basic functionality of the NMD system. The most notable achievements have been the hit-to-kill intercept of IFT-3 and "in-line" participation by the GBR-P, BMC^3, and EWR in IFT-4 and IFT-5. (Additionally, the IFICS was in-line during IFT-5). However, flight tests during developmental testing necessarily make use of surrogate and prototype elements, so the configuration of the NMD system during both IFT-4 and IFT-5 remains a limited functional representation of the objective system.

While a successful intercept during any future flight test will be a significant achievement in the development of the NMD system, it should be seen in the context of the following limitations:

- **Limited Engagement Conditions**. Test target launches from VAFB and interceptor launches from KMR, along with safety constraints, place considerable limitations on achieving realistic engagement conditions with respect to early warning radar tracking, interceptor flyout range, intercept altitude, and closing velocity, as well as other less significant aspects of an engagement. (**NOTE**: *The JPO is investigating alternative intercept flight configurations, which will attempt to achieve longer range and higher velocity intercepts.)*

- **Artificiality/GBR-P Siting**. The prototype XBR (GBR-P), which is located at KMR, is not sufficiently forward in the test geometry to adequately support weapon task planning by the BMC^3. As a result, GPS instrumentation or a C-band transponder on the target RV are used as the principal sources of tracking and identification data for such functions. (**NOTE**: *The JPO is investigating the location of additional mid-course tracking radar to eliminate this limitation.)*

- **Target Suite Reduction**. In addition to the target deployment bus, the target suites flown in IFTs 3, 4, and 5 each contained only two objects (a Medium Re-entry Vehicle and a Large Balloon). The additional two small balloons that had been called out in the 1999 TEMP were eliminated. This was also a significant reduction in complexity from the 1997 TEMP (ten objects for IFTs 3 and 4 and nine for IFT-5, although it is acknowledged that the objectives changed for IFT-3 and 4). The 1999 TEMP number of target elements will not be flown until IFT-8. The 1997 level is not currently planned for any intercept flight test and it does not appear the JPO intends to change that plan. (**NOTE**: *The JPO is looking to refocus the content and purpose of RRFs to increase the level and intensity of countermeasure flight testing.)*

- **Target Suite Complexity.** The current NMD test program is designed to examine a narrowly defined C1 threat space that includes only unsophisticated countermeasures such as simple balloons. The currently defined, most stressing intercept test plans call for using a collection of such simple balloon decoys that approximate the re-entry vehicle IR and radar signatures. However, the missiles currently deployed by the established nuclear powers employ countermeasures that exceed the C1 definition of unsophisticated. The test program needs to broaden the scope of countermeasure testing if it is to quantify not only the "residual" capability that is part of the NMD operational requirements, but also assess the design margin and growth potential of the system design. (**NOTE**: *The JPO is looking to refocus the content and purpose of RRFs to increase the level and intensity of countermeasure flight testing.)*

- **Multiple Simultaneous Engagements**. NMD system performance against multiple targets is not currently planned for demonstration in the flight test program, although multiple engagements are expected to be the norm in NMD system operation. (**NOTE**: *The JPO is now planning for such flight testing and investigating options.)*

- **GBI Booster Testing**. Developmental delays of the tactical booster have pushed boost vehicle testing back about 18 months. As a result, the first use of the operational booster stack in an IFT will now occur in IFT-8 (scheduled for 3QFY02), vice IFT-7 as originally planned. This will defer the decision on the procurement of long-lead interceptor hardware from the FY01 DAB to some later point in 3QFY02.

VALUE ADDED

DOT&E has voiced significant concern about the limitations of testing to date and the robustness of future testing to support a deployment decision for an effective NMD system. The Department is developing revised plans for the NMD program, which is attempting to address those limitations.

RECOMMENDATIONS

The NMD testing program of record was intended to accommodate an aggressive pace of development. However, the program is not aggressive enough to match the pace of acquisition to support deployment and the test content does not yet address important operational questions. Because ground test facilities and models and simulation for assessment are considerably behind schedule, a more aggressive testing program, with parallel paths and activities, will be necessary to adequately stress design limits and achieve an effective IOC by the latter half of this decade. This means a test program that is structured to anticipate and absorb setbacks that inevitably occur. In our DRR Report, DOT&E made a series of recommendations which are discussed below:

- Target suites used in integrated flight tests need to incorporate challenging unsophisticated countermeasures that have the potential to be used against the NMD C1 system (e.g., tumbling RVs and non-spherical balloons).

- Discrimination by the radar and EKV should be given more weight in performance criteria. All other aspects of the NMD performance requirements appear to be within the state of the art of technology. Discrimination by the EKV, on the other hand, will be the biggest challenge to achieving a hit-to-kill intercept.

- Test range limitations need to be removed to adequately test the NMD system; i.e., use of the FPQ-14 range radar tracking the C-band transponder as the source of weapon task planning by the BMC^3 needs to be phased out. Target trajectories or radar locations (GBR-P and UEWR) need to be changed to permit the organic NMD system to provide early radar cueing and mid-course discrimination with the appropriate degree of position and velocity accuracy. It may require significant funding increases to implement this recommendation; however, since the NMD flight testing program is likely to continue for many years until and throughout deployment, the investment to remove this significant limitation seems warranted.

- While the current disciplined testing approach of not firing any flight test until all anomalies from a preceding flight test are thoroughly understood is good traditional engineering practice, an FY05 IOC of an effective NMD system appears unlikely under this paradigm. Program options should consider a much more parallel approach whereby flight testing can continue at an aggressive pace in the wake of a possible failed intercept.

- An innovative new approach needs to be taken towards HWIL testing of the EKV, so that potential design problems or discrimination challenges can be wrung out on the ground in lieu of expensive flight tests. DOT&E strongly recommends the initiation of an intensive effort to develop a flexible, comprehensive HWIL facility with high fidelity target-scene representation for the design and testing of the EKV. The Current JPO plan to leverage HWIL facilities at existing government sites is a good initial step, but the technology and methodology associated with those facilities need to be advanced to create a challenging, realistic, and interactive environment.

Finally, DOT&E recommends that the growth path from Capability 1 to Capability 2 or 3 be rigorously defined and evaluated. A program to reach C2 or C3 will involve more demanding scenarios in a complex operational architecture than that required of C1. The program office needs to ensure that such growth is realizable.

NAVY AREA THEATER BALLISTIC MISSILE DEFENSE (NATBMD)

Navy ACAT ID Program		**Prime Contractor**
Total Number of Systems:	1,500 missiles	Raytheon Missile Systems Company
Total Program Cost (TY$):	$6710M	Lockheed Martin Naval Electronics &
Average Unit Cost (TY$):	$2.4M	Surveillance Systems (AEGIS systems)
Full-rate production:	3QFY03	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Navy Area Theater Ballistic Missile Defense (NATBMD) system is intended to minimize the vulnerability of U.S. forces and population areas against the theater ballistic missile threat. The mission of NATBMD is to protect amphibious assault forces and coastal cities from short to medium-range ballistic missiles without degrading current Standard Missile capabilities against manned aircraft and cruise missiles. The NATBMD system contributes to three of the four ***Joint Vision 2020*** operational concepts: ***full-dimensional protection, precision engagement, and dominant maneuver***. Navy Area supports:

- ***Full-dimensional protection*** by defeating incoming short and medium range ballistic missiles to assist in controlling the airspace.
- ***Precision engagement*** by contributing to a Theater Ballistic Missile Defense (TBMD) family of systems that can locate TBMD targets, provide command and control, engage targets, and assess level of success.
- ***Dominant maneuver*** by the application of information, engagement, and mobility capabilities to accomplish a lower-tier TBMD defense.

The NATBMD system consists of the following:

- Standard Missile-2 (SM-2) Block IVA, which incorporates an infrared seeker, a radio frequency adjunct sensor, forward-looking predictive fuze, and an improved auto-pilot to the proven Block IV airframe.

- Upgrades to the AEGIS Weapon System to enable tracking and engagement of high-speed, low radar cross-section, theater ballistic missiles (TBMs).

- Upgraded Link 16 message set that provides interoperability with Navy, other Service theater ballistic missiles defense systems, and command and control systems.

BACKGROUND INFORMATION

The NATBMD system entered EMD in March 1997. Program Demonstration and Risk Reduction (PD&RR) activities have been reported in previous annual reports and will not be recounted in this year's report. EMD flight testing commenced at the White Sands Missile Range (WSMR) in June 2000.

Prior to Milestone III and fleet introduction, the Navy originally planned to deploy an interim theater ballistic missile defense capability called LINEBACKER. Although still planned as a development phase of the program, this capability has now been defined by the user as an engineering, development and risk-reduction effort in support of the fully capable, tactical objective system. LINEBACKER ships and computer program permit early involvement of fleet users in system testing and integration. LINEBACKER ships have either a theater ballistic missile defense capability engaging unitary targets only *or* an anti-air warfare capability. The objective system will be able to engage all threats (unitary and separating) simultaneously. LINEBACKER is limited by a reduced track filter capability and physical separation constraints for object resolution, all of which contribute to a smaller defended footprint compared to that of the objective system. The LINEBACKER system consists of a LINEBACKER version of the AEGIS Weapon System software installed on two cruisers. Thirty-five EMD/LINEBACKER test missiles will be procured. Twenty-five of the 35 LINEBACKER missiles will be used in at-sea testing during DT/OT and OPEVAL, with the remainder used for other testing.

TEST & EVALUATION ACTIVITY

The NATBMD TEMP was approved in February 1997 and is currently undergoing revision. The TEMP includes the complete test matrix for LINEBACKER, DT, and OT. Modifications to the OT flight test matrix are in place as part of this TEMP revision. The EMD phase of testing will examine performance against ballistic missiles, aircraft, cruise missiles, multiple targets, and debris and countermeasures environments. Supporting the FY03 Milestone III decision are four major test phases:

- FY00-FY02: DT/OA consisting of eight missile firings at WSMR against surrogate TBM and cruise missile targets (without the AEGIS/SPY-1 Radar).

- FY02: At-sea tests consisting of three missile firings against threat-representative targets at the Pacific Missile Range Facility (PMRF), Kauai, HI. These tests will be the first to utilize the fully integrated AEGIS/SPY-1 radar and SM-2 Block IVA missile.

- FY02: 1998 Iranian Missile Protection Act (IMPACT 98), a test mandated by Congress to determine the capability of lower-tier Ballistic Missile Defense systems against medium-range ballistic missile threats. The test will consist of a target tracking event for characterization and a single Block IVA firing against a long-range target at Kwajelain Atoll.

- FY02-03: Twelve DT and thirteen OT firings at PMRF against real and surrogate TBMs and cruise missile targets.

In FY00, the Navy began the DT/OA series of flight tests at WSMR with two Control Test Vehicle tests (CTV-1 June 2000 and CTV-2 August 2000). The firings were conducted without a target to gather data on the performance of the upgraded autopilot and modified airframe of the SM-2 Block IVA. Both tests successfully demonstrated the planned response and performance of the autopilot and airframe. The successful completion of both shots satisfies exit criteria for long-lead component procurement to support SM-2 Block IVA LRIP. The commencement of intercept flight testing at WSMR is currently scheduled for 4QFY01.

The LINEBACKER system, deployed onboard USS LAKE ERIE (CG-70) and USS PORT ROYAL (CG-73), has generated tremendous value-added to the overall Naval TBMD development process. Recently, the Chief of Naval Operations removed USS LAKE ERIE from its battle group and declared her a dedicated TBMD test asset. During the past year, LINEBACKER ships have participated in a wide range of joint exercises, including Slugger in 3QFY99, the Theater Missile Defense Critical Measurements Program-3A (TCMP-3A) in 4QFY99, and Pacific Blitz in 3QFY00. These exercises demonstrated the ability of LINEBACKER ships, operating in TBMD stand-alone mode, to detect and track non-separating TBMD targets and cue other sensors and TBMD systems. However, LINEBACKER has yet to perform a live SM-2 Block IVA engagement against a TBM target.

For at-sea system testing in FY01, using the LINEBACKER system, the Navy plans to employ one Lance and two Short-Range Air-Launched Targets (SRALTs). SRALT is the only existing mobile target available to the Navy Area program. However, at present, SRALT suffers from two main deficiencies: (1) the infrared signature of SRALT is not threat-representative; and (2) the downrange accuracy of SRALT does not meet the requirements needed for Navy Area testing. Contractor recommendations for improving SRALT endpoint accuracy and threat infrared signature representation were submitted as part of a government-sponsored review. In 3QFY00, a contract for procurement of SRALT vehicles was awarded which should address SRALT shortfalls.

The NATBMD LFT&E strategy for static warhead arena tests, dynamic warhead sled tests, direct hit sled tests, flight tests and other ancillary tests and simulation analyses was approved by DOT&E in August 1996. DOT&E approved the test plan for the SM-2 Block IVA warhead arena tests in November 1997. Phase I arena testing concluded in April 1998. DOT&E approved the test plan for dynamic warhead sled testing in July 1998. Phase I warhead sled testing was conducted at the Holloman AFB High-Speed Test Track in Alamogordo, NM, from July 1998-January 1999, with the test warheads flying at approximately 5,000 ft/sec. A dynamic warhead sled test report was published in June 1999. Warhead sled testing was followed by a direct-hit sled testing series in late 1999. A total of three tests were carried out at Holloman AFB, with the missile surrogates flying at approximately 4,000 ft/sec. Based on the successful results of those tests, the Phase II direct hit sled test series was cancelled and the targets were allocated to other lethality tests. Phase II warhead arena test series included one warhead arena test and two fragmentation mat projector tests against high-explosive targets. The test series was completed in January 2000. The direct-hit sled test series included:

- Direct-Hit Sled Test-2A (DST-2A). On August 26, 1999, the Navy fired an SM-2 Block IVA surrogate against a TBMD nuclear payload replica designated as the SRNT. The target was defeated.

- Direct-Hit Sled Test-1B (DST-1B). On October 5, 1999, the Navy fired an SM-2 Block IVA surrogate against a CSM target. The target was defeated.

- Direct-Hit Sled Test-2B (DST-2B). On December 2, 1999, the Navy fired an SM-2 Block IVA surrogate against a TBMD nuclear payload replica designated as the GRNT. The target was defeated.

Phase II warhead sled testing was conducted through November 2000, with the test warheads flying at approximately 5,000 ft/sec. The warhead sled test series was supplemented by a fragmentation mat projector test series. The remaining lethality information will come from flight testing. The warhead sled test series included:

- Warhead Sled Test-6B (WST-6B). On March 23, 2000, the Navy fired an SM-2 Block IVA test warhead against a TBMD nuclear payload replica designated as the GRNT. Preliminary indications are that the target was defeated. Further detailed evaluation is underway.

- Warhead Sled Test-5B (WST-5B). On August 2, 2000, the Navy fired an SM-2 Block IVA test warhead against a sight classified, high interest TBMD nuclear payload replica designated as the Re-entry Body Ballistic Target (RBBT). Preliminary indications are that the target was defeated. Further detailed evaluation is underway.

- Warhead Sled Test-3 (WST-3). On August 31, 2000, the Navy fired an SM-2 Block IVA test warhead against four TBM-payload targets, featuring a demonstration of the Bulk Chemical Replica flight test target sensor and instrumentation package that will be used in WSMR DT flight testing. The warhead did not detonate as planned, resulting in a no-test. The test was repeated successfully on November 1, 2000.

The warhead sled test series was supplemented by fragmentation mat projector tests in FY00. The remaining lethality information will come from flight testing.

TEST & EVALUATION ASSESSMENT

The Navy, AEGIS, and Standard Missile contractors have a long history of evolutionary development of the AEGIS and the Standard Missile systems. However, the Navy has yet to demonstrate via live testing, an integrated system (AEGIS and Standard Missile) capable of acquiring, tracking, and intercepting theater ballistic missiles. The PD&RR phase and LINEBACKER test events have demonstrated that the AEGIS SPY-1 radar can track a theater ballistic missile and, in a separate test, an early prototype version of the SM-2 Block IVA demonstrated that it could engage and intercept a Lance target using guidance data from White Sands Missile Range tracking instrumentation. A number of technical risks and challenges exist. They include:

- Forward Looking Fuze (FLF): The FLF detonates the SM-2 Block IVA warhead at the optimal time to strike the TBM in the payload section. The FLF is unique to the Block IVA and is required to meet the stressing engagement timeline and lethality requirements of TBMD. For the FLF, the Navy must verify slaving the radar tracker to the infrared seeker, real-time processing data fusion, and burst time accuracy to achieve desired warhead effects at the proper location on the target.

- Infrared Seeker Dome Cooling System (DCS) Redesign: During the PD&RR flight, the infrared seeker experienced an aero-optical high-background noise anomaly that was most likely caused by contamination of the seeker dome by the DCS. The design of the DCS was consequently modified. Although tested in the wind tunnel, the modified DCS has not been flight tested.

- AEGIS Weapon System Computer Program Complexity: The AEGIS system may have difficulties maintaining both ballistic missile and anti-air warfare missions given the high radar loading levels required for multiple, high-speed, low radar cross-section theater ballistic missile targets.

- Linear Search and Track Processor (LSTP) Development: The LSTP is an adjunct processor that improves the object resolution and detection range of the AEGIS radar. This processor is required for resolving closely spaced objects at long-range, such as separating re-entry vehicles.

- Target Discrimination: For certain threats, objects such as booster tanks and attitude control modules can exhibit discrimination characteristics that resemble those of the target payload vehicle. This poses a particular challenge to the system's discrimination capabilities and protocol. For such cases, robust primary and secondary means of discrimination are required that can identify the target for all TBMs in the NATBMD ORD defined threat set. To properly understand the NATBMD system's capabilities and limitations relative to this discrimination challenge, and to assess effectiveness and suitability, a robust modeling and simulation effort anchored by appropriate flight-testing must be developed and executed. Such a robust testing effort is currently not planned and will require additional test assets and funding.

In 1998, utilizing lessons learned from the Welch Panel on Ballistic Missile Defense, two risk reduction flights were added to the WSMR flight test schedule. These risk reduction flights were intended to address the Forward Looking Fuze and Dome Cooling System technical risks identified above. However, following a program re-baseline in FY99-00, a risk-reduction flight to test modifications to the infrared seeker DCS was dropped, and the test objectives were moved to CTV-2. On account of technical delays to the start of DT/OA flight testing in FY99-00, the Navy has since deferred testing of the DCS to the third DT/OA shot (the TBM Fly-By mission). This delays DCS flight testing and risk mitigation pertaining to the unresolved aero-optical background anomaly. The schedule changes have also increased the significance and risk of the TBM Fly-By test and the TBM-1 test, which will be the first in-flight test of both the DCS and the FLF.

Along with the DT/OA Target Fly-By mission and TBM-1 mission, FLF mitigating actions include a series of ground-test experiments from FY97-FY01. The most recent and comprehensive tests include miss-distance measurements using artillery shells and an integrated Block IVA guidance section. The FLF ground experiments to date have provided valuable risk reduction to evaluate FLF performance before DT/OA testing. However, because ground tests alone cannot fully assess the adequacy of FLF hardware to meet the fuze timing requirements, the FLF will remain a program risk item until it is fully flight qualified and tested.

The size and complexity of the AEGIS Weapons System computer program is significantly greater than in any previous AEGIS Weapons System baseline. To reduce the risk, the Navy has re-phased code development, added testing, simplified the AEGIS display system, and utilized commercial-off-the-shelf vendor technical support. Likewise, the risk associated with the completion of the SPY and LSTP element integration and testing has prompted the Navy to de-scope non-essential requirements and increase integration and testing time. In spite of these adjustments, the progress of development and testing of the AEGIS Baseline 6 Phase III software (TBMD Tactical objective software build) is lagging projections but does not yet impact DT/OT test schedules. The complexity of the undertaking may have been underestimated.

The challenges associated with target discrimination may limit the NATBMD system's ability to counter all existing and near-term threats referred to in the Navy Area Operational Requirements Document. To address DOT&E's concerns in this area, testing designed to evaluate the discrimination capability of the Navy Area system will have to be added to the revised TEMP. The test will evaluate both the primary and secondary means of discrimination for the Navy Area system against threats identified in the ORD.

The interoperability requirement from the Navy Area program Operational Requirements Document is Link-16 capability. The Navy, during its TBMD exercises, routinely establishes a Link-16 network with other TBMD nodes (PATRIOT and THAAD) either via gateways or over-the-air. These early networks have proved valuable to the Link 16 message verification process and have provided worthwhile training opportunities for all TBMD players.

Ballistic missile target verification, validation, and accreditation are a concern. Pending modifications to SRALT should satisfy the Navy Area target requirements for LINEBACKER at-sea testing, but the time required to develop and procure threat-representative targets for future flight test phases may not support the existing schedules. Sufficient funding to permit the initiation of operationally realistic target build and purchase is also at issue. The T&E community is working with the Navy and BMDO to resolve these target issues.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

Notwithstanding the aforementioned risk areas, the program is technically solid. There are several remaining issues that could challenge the development and test schedule.

- Continued compression of the DT/OA flight test schedule has curtailed the risk-reduction activities associated with each test and may ultimately delay the flight test schedule itself.
- The missile and AEGIS development programs must both proceed without significant difficulties to maintain a tight schedule. Based upon developments this past year, neither of these seem capable of maintaining schedule.
- The development and procurement of the target surrogate set must progress at an aggressive pace to satisfy threat-representative target requirements and meet the flight test schedule.

NAVY THEATER WIDE (NTW)

Navy ACAT I-D Program

Total Number of Systems:	4 Ships, 80 Missiles
Total Program Cost (TY$):	$5,493M
Average Unit Cost (TY$):	$11.275M
Milestone II:	1QFY04
Full-rate production:	3QFY07

Prime Contractor

Raytheon Missile Systems Company (missile)
Lockheed Martin Government Electronic Systems (AEGIS Ship)

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Navy Theater Wide (NTW) system is a response to the vulnerability of U.S. forces and protected populations to the ballistic missile threat. The mission of NTW is to provide upper-tier protection against medium to long-range threats. NTW will provide the capability to intercept Theater Ballistic Missiles from exoatmospheric ascent phase through exoatmospheric descent. The NTW system contributes to three of the four ***Joint Vision 2020*** operational concepts: ***full-dimensional protection, precision engagement, and dominant maneuver***. NTW supports:

- ***Full-dimensional protection*** by defeating incoming exoatmospheric ballistic missiles to assist in controlling the airspace.

- ***Precision engagement*** by contributing to a Theater Ballistic Missile Defense (TBMD) family of systems that can locate TBMD targets, provide command and control, engage targets, and assess level of success.

- ***Dominant maneuver*** by applying information, engagement, and mobility capabilities to accomplish an upper-tier TBMD defense.

The NTW program consists of the Standard Missile-3 (SM-3) and upgrades to the AEGIS Weapon System. The SM-3 evolves from the SM-2 Block IV booster and sustainer motor by the addition of a third-stage rocket motor and fourth-stage kinetic warhead with a solid-fuel divert and attitude control system guided by an infrared focal plane array seeker. The AEGIS Weapon System will be modified to enable longer-range, exoatmospheric theater ballistic missile detection, tracking, discrimination, and engagement.

BACKGROUND INFORMATION

The genesis for NTW was the TERRIER Lightweight Exoatmospheric Projectile (LEAP) demonstration program, which occurred from September 1992-March 1995. The TERRIER LEAP program consisted of four modified TERRIER missile flight tests. Two flight tests occurred without targets, and two flight tests occurred against targets. The two intercept attempts failed. One of the failed intercepts was due to a software error and the other was due to battery failure. However, sufficient technical progress was made to warrant further development work and the AEGIS LEAP Intercept (ALI) program was created. The objective of the ALI program is to demonstrate intercept of a ballistic missile target in exoatmospheric flight.

Milestone I occurred in spring 1999. The Program Definition and Risk Reduction test program and TEMP were approved. The FY99 TEMP outlines the test strategy for a Block I development plan. The NTW Block I system will use an SM-3 missile with a single-color, long-wave infrared seeker and an upgraded AEGIS Weapons System that will include high-range resolution and a new signal processor for added radar discrimination capability against separating targets. The Block I missile in its final form will defend against TBMD and Anti-Air Warfare (AAW) targets. Research is advancing for the potential development of a Block II missile with improved infrared and radar discrimination capability; however, there is currently no funding for development and acquisition of the Block II system. Funded plans for a Block II system feature a two-color infrared seeker, improved propulsion (axial and divert), and the integration of a high-power radar into the AEGIS Weapon System.

As part of the revised Upper Tier Strategy of 1999, major changes to the NTW Block I program plan and TEMP have been in work to facilitate earlier fielding of system capability. This modified program plan proposes an evolutionary acquisition strategy that divides Block I development as outlined in the FY99 Program of Record into three smaller development increments (Block IA, IB, and IC). Block IA contingency capability defeats non-separating and simple separating threats; Block IB is a single-mission (TBMD-only) capability that defeats all Block I TBMD threats; and Block IC is a multi-mission (AAW and TBMD) capability that satisfies the requirements of the Block I system under the FY99 Program of Record. Under the modified plan, the ALI project will continue with project objectives and flight test matrix unchanged. Research toward a Block II system with enhanced discrimination and lethality capabilities will continue as well.

TEST & EVALUATION ACTIVITY

The Navy Theater Wide program is currently in the ALI program flight test phase. The ALI flight test series consists of nine missile firings from 4QFY99-3QFY02. The first two flights, Control Test Vehicle-1A (CTV-1A) and Flight Test Round-1 (FTR-1), were SM-3 missiles flying on trajectories against simulated targets. The third flight, FTR-1A, will repeat the objectives of the unsuccessful FTR-1 flight and may briefly acquire a single-stage ARIES target with the IR seeker. The fourth flight, FTR-2, will obtain seeker characterization data of the ARIES target with target intercept possible. FTR-3 through FTR-7 will be ARIES target intercept attempts.

Following ALI testing, the evolutionary program plan proposes nine firings as part of a developmental test/operational assessment (DT/OA) phase during FY04-06. These DT/OA firings will be descent and ascent phase engagements against threat-representative, non-separating targets and ascent phase engagements against threat-representative, separating targets. A minimum of three flight tests will support the OA, the results of which will be used to evaluate the production readiness of the Block I missile.

In September 1999, the Navy conducted the ALI CTV-1A flight test from the Pacific Missile Range Facility on Kauai, HI. CTV-1A demonstrated airframe stability and control of the SM-3 missile through second/third stage separation. In July 2000, the Navy conducted the second ALI flight test, FTR-1, from the Pacific Missile Range Facility. The primary objective of the test was to maintain airframe stability and control of the SM-3 through kinetic warhead separation using the third-stage rocket motor. The FTR-1 third-stage failed to separate from the second stage following second-stage burnout, and the primary objective was not achieved. An FTR-1A shot in 2QFY01 will attempt to complete the FTR-1 primary objective.

The Navy is developing the LFT&E strategy for NTW. In late 1996, the Navy instituted a multi-year pre-Milestone II SM-3 Lethality and Analysis Program, in conjunction with the ALI program, to reduce risks associated with missile lethality. The lethality program includes:

- Light-gas gun testing with sub-scale replicas of the kinetic warhead.
- Target vulnerability model development.
- Direct-hit lethality sled testing.
- Hydrocode analyses.
- Other ancillary tests and analyses.

Those tests and analyses also support the development and design validation of SM-3 as well as the Verification, Validation and Accreditation of computer models used to evaluate its lethality.

There was no lethality testing of SM-3 in FY00. Navy SM-3 activities focused on building test targets for FY01 testing and getting the test facilities ready to conduct three SM-3 Direct Hit Sled Tests (scheduled for 3QFY01) and a Light Gas Gun Test Series. Other activities for FY00 included aimpoint selection and lethal volume analyses (using hydrocodes), end game model development, and flight test support (primarily ALI damage predictions). Navy NTW tests and analyses are scheduled to continue through 2003.

TEST & EVALUATION ASSESSMENT

NTW faces several technical challenges:

- Ascent phase intercept. This will be attempted during DT/OA flight testing prior to the fielding of Block IA contingency capability.

- Infrared seeker obscuration. The potential obscuration of the infrared seeker by the kill vehicle Solid-fuel Divert and Attitude Control System (SDACS) propellant plume is an identified risk area to the program.

- Infrared seeker discrimination. A single-color, vice a two-color system may limit the capability of the infrared sensor to discriminate target reentry vehicles from debris, such as fuel chuffing or target plume, and from separating stages, such as booster tanks and attitude control modules.

- AEGIS radar detection and tracking. The AEGIS radar is designed for acquisition and tracking of relatively large aircraft targets and may have insufficient power to autonomously acquire low-signature ballistic missile targets at long-range. External cueing of the radar may ameliorate this challenge.

- SDACS development. Development of critical technologies unique to the NTW program, such as SDACS non-legacy hardware, poses a risk to the program because of the lack of prior flight-test qualification.

The Navy is conducting an extensive ground test program to characterize the effects of infrared seeker obscuration and will collect in-flight data during the ALI phase. To fully understand the effects of obscuration, it is essential to test during periods of solar illumination of the propellant plume. In response to DOT&E's concerns regarding the effects of solar illumination, a daytime flight test has been incorporated into the ALI test series.

During the past year, risk reduction efforts involving the single-color infrared seeker showed continued progress via the SM-3 Captive Carry program on the Airborne Surveillance Test bed (AST). AST carried an SM-3 infrared seeker assembly on several tests involving targets of opportunity. The Captive Carry test bed has allowed the program to characterize the SM-3 Block I infrared sensor and develop Radio Frequency (RF) to Infrared (IR) handover algorithm development software to be used in flight testing.

To further reduce the potential risk associated with the IR seeker, the development of two-color seeker technology should be accelerated. Two-color technology would significantly improve seeker discrimination over the proposed Block I capability. This technology shows promise and has the potential to be incorporated into the program during Block I development.

As part of the NTW Block II risk-reduction effort, two radar prototypes are in development: an X-band high power discriminator and a solid-state SPY-1E radar. The X-band system is a ship add-on radar based on THAAD radar technology; the SPY-1E radar, which is an S-band solid-state multi-function radar, is an upgraded replacement to the existing SPY-1 radar. In the near-term, simultaneous development of both radar prototypes will continue until a preferred option is identified. Full program funding of radar development could allow fielding of a Block II radar system to coincide with Block IA fielding under the evolutionary program plan. Early development and fielding of a Block II radar system could greatly reduce the risk associated with the Block I radar system by improving its detection range and object resolution.

During the past year, ground-test qualification of critical NTW technologies has met with mixed results. Recent SDACS ground testing has revealed faults, which will delay the first ALI intercept attempt by at least six months. One of the primary faults pertains to the rhenium coating of the fluidic ball divert valves of the SDACS main thruster assembly. A mismatch in material thermal expansion properties caused the rhenium coating to crack and delaminate during ground tests. The SDACS is the final element requiring verification prior to intercept. The Navy is taking steps to isolate the faults and apply and verify corrective actions, which include assembling a technical review team of senior independent experts to review both the design and execution of the current SDACS. The ALI flight test matrix has also been modified with fewer design changes during the early part of the ALI phase. In contrast, ground-test qualification has gone well for the third-stage rocket motor—another non-legacy hardware element of the SM-3. An earlier problem with the third-stage rocket motor has been corrected, and six successful ground tests have been conducted in the past year with no impact on schedule.

The SM-3 Lethality and Analysis Program is building a solid foundation for future LFT&E activities. The program is addressing many of the lethality issues early on and developing test techniques that can be employed in future lethality testing.

The effort during the past year to re-baseline the NTW program to facilitate earlier acquisition posed immediate challenges to adequate operational testing before production. To address DOT&E's concerns in this area, OA firings before the start of LRIP have been incorporated into the re-baseline plan. The results of the OA flights should provide an adequate assessment of Block I system effectiveness and suitability for the production decision. Also, in response to DOT&E's concerns on the lack of separating-target flight testing before Milestone II in the FY99 Program of Record, funding has been re-directed to accelerate the development of the common signal processor. The common signal processor is required for testing against separating targets. As a result, flight testing against separating targets will occur earlier than planned in the FY99 Program of Record and before LRIP under the re-baseline plan.

NTW has received recent attention for its possible role as a sea-based option and/or supplement to a land-based National Missile Defense (NMD) system. However, to accomplish the NMD mission, several elements of the baseline NTW program would require major upgrades.

- ***Radar*** – The AEGIS AN/SPY-1 B/D radar is not capable of supporting NMD-class engagements due to its limited detection and tracking range for strategic (long-range) ballistic missiles and their reentry vehicles. In order for the NTW ship to support its own NMD engagements, a major upgrade to the AEGIS radar is required. The aperture size, beam width, frequency, and bandwidth of the SPY-1 radar are unsuitable for NMD. The small aperture size would severely limit the detection capability of the radar against long-range NMD threats. The large SPY-1 beam width would degrade the track accuracy required for a small predicted "hand-over basket" for the NMD kinetic warhead. Likewise, the SPY-1 frequency and bandwidth are not optimized for discrimination of NMD targets in mid-course flight. Alternatively, an adjunct radar could be added to the ship (e.g., a steerable single-face

X-band radar mounted to the ship. Upgrading the SPY-1 radar or adding an adjunct radar would be a major modification.

- ***Missile*** – To utilize the current NTW SM-3 for the NMD mission would require major propulsion upgrades. The NTW Block I SM-3 lacks the velocity required for ascent or mid-course intercepts of long-range ballistic missiles (intermediate and intercontinental ballistic missiles [IRBMs and ICBMs]). The burnout velocity of the SM-3 missile is less than half of that required for mid-course engagements of high-velocity NMD targets. Using the current Block I SM-3 to conduct NMD engagements would result in an inadequate defended area.

- ***Kinetic Warhead*** – Several major upgrades or a full re-design are required before the NTW kinetic warhead (KW) could be used for the NMD mission. The NMD mission requires the KW or the kill vehicle (KV) to be nuclear hardened. The current NTW KW does not meet this requirement. Engaging the most difficult NMD threats would require the NTW KW to have capabilities similar to those found in the NMD exo-atmospheric kill vehicle (EKV). For the NMD mission, the current NTW KW lacks the required NMD endgame performance due to the limited detection range of its IR seeker and the lack of divert velocity available with the current divert and attitude control system. A second color for the IR seeker would also be required to achieve adequate endgame discrimination for advanced IRBM and ICBM threats.

Based on the above major shortcomings, DOT&E does not consider NTW or a near-term (within 5 years) upgrade of NTW to be a viable sea-based NMD option. This conclusion is supported by an ongoing Concept Definition Study (CDS) conducted by the Ballistic Missile Defense Organization (BMDO) and the Navy that, in general, assumes the above modification in the missile, KW, radar, and BM/C^3. BMDO and the Navy formed a CDS team in August 1999 to respond to the congressional Fiscal Year 2000 National Defense Authorization Act, which requests a report evaluating options for supplementing NMD architecture with sea-based assets. A separate report to Congress on the results of Part I of the Naval NMD CDS has been drafted and is currently being coordinated within the Department of Defense.

RECOMMENDATIONS, CONCLUSIONS AND LESSONS LEARNED

The proposed evolutionary acquisition strategy poses inherent challenges to adequate operational testing supporting production and fielding of each Block upgrade. The program philosophy (to date) that incorporates operational testing into the flight test matrix, in advance of production, is strongly encouraged and supported.

Future flight test success and/or schedule pressures have the potential to curtail flight testing that might otherwise provide valuable risk-reduction. The potential for a schedule-driven approach that prematurely curtails flight testing to advance the program is a concern.

The current funding levels for the Block I program have forced the Navy to focus on the early fielding of Block I at the expense of developing Block II technologies. The two-color IR seeker and high power discrimination radar are slated for the objective Block II system, which is intended to address the 2010 threat. However, the advanced IR seeker and radar systems are funding, not technology constrained, and could be fielded early in conjunction with the Block I systems. The addition of either the two-color seeker or the advanced radar would greatly improve the effectiveness of the Block I system against certain classes of existing threats. Developing and fielding NTW Block I, knowing it will only partially address the existing threat at fielding, remains a concern. The technology to achieve the Block II system is available and should be incorporated as soon as possible.

PATRIOT ADVANCED CAPABILITY-3 (PAC-3)

DoD ACAT ID Program		**Prime Contractor**
Total Number of Systems:	36 Tactical Fire Units	Raytheon
Total Program Cost (TY$):	$6093M	Lockheed Martin Vought Systems
Average Unit Cost (TY$):	$169M	
Full-rate production:	1QFY02	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The PATRIOT is an air-defense, guided-missile system originally designed to counter the air-breathing threat of the 1990s and beyond. Two modifications, PATRIOT Advanced Capability 1 and 2, were added to provide a limited capability for defense against tactical ballistic missiles. The key features of the PATRIOT system are the multifunctional phased-array radar, track-via-missile guidance, and extensive modern software and automated operations, with the capability for human override.

The PATRIOT Advanced Capability-3 (PAC-3) growth program is being implemented through a series of three stand-alone fielding configurations. Configurations 1 and 2 have been fielded. Each configuration consists of a grouping of materiel-change packages and a software upgrade called a post-deployment build, which includes a collection of software product upgrades.

Configuration 1 consists of: (1) an expanded weapons control computer; (2) optical disk drives; (3) an embedded data recorder; and (4) implementing software. These upgrades provide four times greater computer throughput and a more efficient data recording and retrieval capability. Configuration 1 also includes the hardware associated with Radar Enhancement-Phase II, which incorporates a dedicated pulse-Doppler processor.

Configuration 2 includes the Communication Enhancements Phase I, which is a materiel-change package that provides improved external communications (to the PATRIOT battalion), and includes linkage into the Theater Missile Defense (TMD) architecture. Configuration 2 software improvements include: (1) a counter anti-radiation missile capability to minimize vulnerability to those missiles; (2) Classification, Discrimination and Identification-Phase I to improve the Tactical Information Broadcast System interface; and (3) a software implementation of Radar Enhancement Phase II.

Configuration 3 consists of: (1) three materiel change packages, (2) three significant software improvements, and (3) the PAC-3 missile. These improvements were required by the user to significantly improve PATRIOT performance. They also incorporated the DoD mandated conversion of the Information Coordination Central software from JOVIAL to Ada.

The three materiel-change packages are: (1) Radar Enhancements-Phase III, which provides significant improvements in system performance; (2) Classification, Discrimination and Identification-Phase III, which provides a high-range resolution radar capability; and (3) a Remote Launch/Communication Enhancement Upgrade to provide the capability to deploy missiles launchers at remote launcher farms, and improve intra-battalion voice and data communications.

The three software improvements provide: (1) PATRIOT and THAAD interoperability, which optimize the warfighting capability of PATRIOT and THAAD; (2) Joint TMD interoperability, which allows the capability to receive and transmit tactical ballistic missile-related data in a joint-Services environment; and (3) Launch Point Determination, to calculate tactical ballistic missile launch points.

The PAC-3 missile is designed to provide hit-to-kill lethality against high-speed tactical ballistic missiles; maneuvering tactical missiles; low-radar cross-section, 1000 km-range targets in operational environments; cruise missiles; and other air-breathing aircraft.

PAC-3 embodies the ***Joint Vision 2020*** operational concept of ***precision engagement***. It supports ***dominant maneuver*** by our forces and provides ***full-dimensional protection*** for friendly forces and facilities. It incorporates ***focused logistics*** to facilitate rapid deployment in times of crisis. PAC-3 uses ***technological innovation*** and relies on ***information superiority*** to fully support the lower-tier theater air and missile defense mission.

BACKGROUND INFORMATION

Subsequent to Desert Storm, the PAC-3 Operational Requirements Document (ORD) was developed to provide focus for several already planned improvements, plus additional improvements to include a new missile capability. The ORD identifies additional performance requirements needed to counter advanced stealth technology, advanced electronic countermeasure techniques by air-breathing targets, unmanned remotely piloted vehicles, anti-radiation missiles, tactical air-to-surface missiles, and tactical ballistic missiles. The ORD requires that the PAC-3 system be rapidly deployable, robust in firepower, tactically mobile, survivable, low-in-force-structure demands, and able to interoperate with other TMD systems.

Each materiel change package is tested individually and then re-tested as part of a fielding configuration during integrated system testing. Operational testing prior to FY00 included Configuration-2 FOT&E (FOT&E-2), successfully conducted at White Sands Missile Range, NM, and Ft. Bliss, TX, during May-June 1996. The FOT&E-2 consisted of tests using the hardware-in-the-loop Flight Mission Simulator, battalion-level field exercises, and a multiple simultaneous engagement live missile-firing exercise. The live fire test involved a simultaneous engagement by two PAC-2 missiles against a simulated ballistic missile target (a PATRIOT missile) and an air-breathing target (an MQM-107). The MQM-107 was successfully intercepted. The PATRIOT target self destructed before the PAC-2 missile could intercept it. FOT&E-2 evaluated the Configuration 2 (and Configuration 1) materiel-change packages and software improvements. An Operational Assessment based on FOT&E-2 was completed in August 1996. Operational testing for Configuration 3 will not start until the fall of 2001.

Phase 2 of Configuration 3 Developmental Test and Evaluation (CDTE-3) was conducted from May-August 1999, and focused on evaluating enhancements to the ground portion of the system—the Post Deployment Build-5 software; Radar Enhancement Phase-3; Classification, Discrimination, and Identification-3; and Remote Launch/Communication Enhancement upgrades.

CDTE-3 included four flight tests of PAC-2 missiles. The first, on July 16, 1999, tested a Configuration-2 (plus) fire unit against an MQM-107 drone. The other three tests used Configuration-3 fire units. On December 1, 1999, a Guidance-Enhanced Missile (GEM; improved PAC-2) engaged a drone emulating a low altitude low-RCS cruise missile in clutter. This test was not completely successful; problems were revealed with ground radar tracking and PAC-2 fuzing. On December 15, 1999, a PAC-2 missile from a remote launcher intercepted a Lance TBM target. On March 15, 2000, a PAC-2 missile intercepted a POTA-Tow (PATRIOT Omni-directional Training Aerial-Tow) target being towed by an MQM-107 drone.

The PATRIOT ground equipment tested in CDTE-3 had serious reliability shortfalls. The following Configuration-3 major items failed to meet the required mean time between critical mission failure rates for the operational system:

- Engagement Control Station (mission critical failure rate was 5 times greater than allocated).
- Communications Relay Group/Launch Control Station (9.6 times greater).
- Radar Set (2.4 times greater).
- PAC-3 Launching Station (1.3 times greater).
- PAC-2 Launching Station (1.1 times greater).

The total fire unit MTBCMF rate was 2.3 times greater than allocated. As discussed below, the MTBCMF rate was generally better in the LUT, but was still 1.7 times larger than allocated.

Flight-testing of the new PAC-3 missile was completed through DT-3 prior to FY00. In September and December 1997, controlled non-intercept flights of the PAC-3 missile, DT-1 and DT-2, were successfully conducted. Flight-testing of the PAC-3 missile continued with the successful intercept of a Hera TBM target during the Seeker Characterization Flight on March 15, 1999. DT-3 was successfully conducted on September 16, 1999. The target for the Seeker Characterization Flight contained simulated chemical submunitions; the DT-3 reentry vehicle was a simulated bulk chemical warhead. Both the Seeker Characterization Flight and DT-3 missions were conducted with prototype PAC-3 hardware and software configurations and non-tactical seeker software.

TEST & EVALUATION ACTIVITY

Flight Testing

To help clarify the following discussion, it is noted that flight-testing has not necessarily been conducted in numerical order. For example, DT-7 was conducted prior to DT-6. Also, DT-4 was postponed; however, some of the DT-4 test objectives were addresses in other flight tests.

Flight-testing of the PAC-3 missile continued in FY00 with the successful intercept of a unitary Hera TBM target (MBRV-3) during the DT-5 mission on February 5, 2000. DT-5 was the first developmental flight test to use tactical seeker profiling algorithms to determine the aimpoint. Other test objectives included demonstration of remote launch (8 kilometers) capability and intercept of a full-body TBM target performing a low-magnitude helix maneuver. Problems during the test included a 40-second period five minutes before launch when the system reported that it had zero missiles in the launcher, low radio frequency data link signal strength and downlink power during the PAC-3 missile flyout, and unexpected detections in the PAC-3 seeker profiling spectrum. These problems did not affect the test, but could have an impact on PATRIOT system performance in other engagements.

DT-7, the first PAC-3 missile intercept of a cruise missile target occurred on July 22, 2000. In addition to demonstrating missile performance and lethality against a low-altitude cruise missile, DT-7 also demonstrated remote launch and the performance of a cold conditioned launcher, canister, and missile.

Engage on Remote-A (EOR-A) successfully demonstrated PAC-3 capability to engage over-the-horizon targets using data from remote sensors on July 28, 2000. It was the second PAC-3 intercept of a cruise missile target.

The DT-6 flight test was performed on 14 October 2000. This flight test was the simultaneous engagement of a Storm TBM by a PAC-3 missile and an MQM-107 drone by a PAC-2 missile. The PAC-3 missile, canister, and launcher were cold conditioned. The Storm target carried 28 simulated chemical submunitions (filled with water) and released a second object shortly before intercept to test PAC-3 missile discrimination. The PAC-2 target was a MQM-107 drone. Both missiles were launched near simultaneously; the PAC-3 missile intercepted the Storm target just before the PAC-2 warhead detonated past the tail of the MQM-107. While the PAC-2 is designed to destroy targets through use of a warhead and not body-to-body impact, the timing of the warhead detonation was anomalous with only a few fragments impacting the tail of the drone. Post mission analysis clearly shows that this anomaly was the result of a PAC-2 missile hardware failure in a roll rate gyro and not related to the simultaneous engagement. The objective of demonstrating the ability to simultaneously engage targets with both PAC-3 and PAC-2 missile was met.

A summary of all PAC-3 flight tests conducted to date is shown in the following table.

PAC-3 Flight Tests To Date

Flight Test ***(Date)***	**Primary Objective(s)**	**Successful Intercept?**
DT-1 *(29 Sep 97)*	First Control Test Missile (CTM) (no seeker or target)	N/A
DT-2 *(15 Dec 97)*	Second CTM; extended range	N/A
Seeker Characterization Flight *(15 Mar 99)*	Risk mitigation flight; intercept of short-range TBM with submunition payload	Yes
DT-3 *(16 Sep 99)*	Intercept of short-range TBM with bulk chemical warhead	Yes
DT-5 *(5 Feb 00)*	Intercept of short-range TBM with low-magnitude helix maneuver using 8 km remote launch	Yes
DT-7 *(22 Jul 00)*	Intercept of low-altitude cruise missile	Yes
EOR-A (*28 Jul 00*)	Intercept of low-altitude cruise missile	Yes
DT-6 *(14 Oct 00)*	Multiple simultaneous engagement: PAC-3 versus short-range TBM (with submunition payload) and PAC-2 versus ABT threat	PAC-3: Yes PAC-2: *

**** Target successfully engaged but not killed due to hardware anomaly not related to the multiple simultaneous engagement test objective.***

<u>Limited User Test (LUT)</u>

The PAC-3 system LUT was conducted during March-June 2000 at Ft. Bliss, TX, and consisted of a combination of sustained operations field exercises and Mobile Flight Mission Simulator (MFMS) exercises. No missile firings were conducted during the LUT. The LUT was designed to provide data to support the Army's decision to equip the first unit with the PAC-3, Configuration-3 ground system. A LUT regression test was conducted in October 2000 to assess progress in addressing issues identified in the LUT; the data are being analyzed.

<u>Sustained Operations Field Exercises</u>

The LUT sustained operations field exercises were conducted during March 27-April 10, 2000, at Ft. Bliss. Live aircraft flight operations were also conducted in the airspace over McGregor Range, NM. During this test phase the PAC-3 system was employed in the field as a PATRIOT Battalion (Bn) defending against non-TBM targets in a realistic combat environment.

These exercises used a PAC-3 Configuration-3 Bn minus (-) configuration operating with post-deployment build 5 (PDB-5) software. The LUT Bn(-) consisted of one Information Control Central and three fire units, with one Engagement Control Station, one radar set, and eight launcher stations (LS) for each fire unit. These eight launcher stations consisted of a combination of two to four PAC-3 launchers plus four to six PAC-2 launchers, using simulated pre-PAC-3 missiles. These sustained field exercises were broken into two separate events: a 72-hour (3-day) exercise and a 144-hour (6 day) exercise.

The PATRIOT Live Air Trainer (LAT) was used during live air missions. Operations were initiated by tester-generated situational message traffic in accordance with a time-ordered event list. Test controllers in the Air Defense Tactical Operation Center, Tactical Air Operations Module, Tactical Control System, and Information Control Central then passed these messages based on approved campaign scenarios containing non-TBM threats. The threats included live fixed-wing aircraft, unmanned aerial vehicles, cruise missile surrogates, and rotary-wing aircraft flying in accordance with approved threat profiles. The threat fixed wing aircraft also employed Self-Screening Jamming and Stand-Off Jamming. Friendly aircraft flew through friendly corridors and employed IFF (Identification Friend or Foe).

The PAC-3 system was deployed in accordance with its wartime operational mode summary/mission profile, and operated and maintained by representative soldiers using the procedures in the TRADOC test support package. During this test phase the PATRIOT nodes were evaluated on their capability to march order, emplace, initialize, communicate, interoperate, and fight an air battle. Reliability, availability, and maintainability (RAM) test incident reports were collected. These field exercises were conducted during both day and night, and in simulated Nuclear, Biological, and Chemical environments.

Mobile Flight Mission Simulator (MFMS) Exercises

The MFMS test phase of the LUT was conducted from May 1-June 2, 2000 at Fort Bliss. The MFMS is a hardware-in-the-loop (HWIL) real-time PATRIOT system exerciser used to evaluate PATRIOT system performance at the fire unit level against both TBM and non-TBM threats. The MFMS simulates threat targets by injecting RF (radio frequency) target response waveforms into the radar. Scripted multi-target MFMS scenarios permit PATRIOT crews to use tactical hardware and software to participate in simulated engagements.

The primary test elements consisted of the MFMS, PAC-3 radar, Engagement Control Station, and the Communication Relay Group. Other elements included non-tactical Data Transfer Units, acting as simulated launchers. The simulated launchers contained only PAC-2 and Guidance Enhanced Missiles; no PAC-3 missiles were included in the simulated missile inventory.

Nine PATRIOT soldier crews (three persons each) participated in the MFMS tests, which addressed 20 threat scenario vignettes. These vignettes were smaller portions of two larger Northeast Asia and Southwest Asia scenarios. The air defense artillery battalion performed the placement of the launchers in each vignette two weeks prior to the start of the MFMS test phase. Five replications were conducted for each vignette, for a total of 100 trials.

Data collection was primarily automated. The system Embedded Data Recorders collected most of the performance data. Other data that was collected during these trials included RAM test incident reports, and manpower and personnel integration surveys at the end of the trials.

Live Fire Test & Evaluation

The LFT&E program planned in the TEMP uses data from a combination of sled tests, light gas gun tests (LGG), and simulations to determine the lethality of the PAC-3 hit-to-kill missile. The High-Speed Test Track (HSTT) at Holloman AFB, NM, was used to test the full-scale PAC-3 missile forebody against a full-scale target. The maximum achievable velocity on the full-scale track is at the lower end of the range of expected intercept velocities, necessitating the use of scaled testing via the LGG. The LGG G-Range at Arnold Engineering Development Center, Tullahoma, TN, was used to test 40-percent subscale PAC-3 missile forebodies intercepting scaled targets at higher velocities more representative of the expected intercept conditions. Physics-based hydrocode simulations and use of the PEELS model complemented testing.

All sub-scale light gas gun testing was completed by 2QFY99. Fourteen of 15 full-scale sled tests against unitary and submunition chemical, high-explosive submunition, nuclear, and biological submunition targets have also been completed. The remaining full-scale test, replication of the DT-6 flight test on the HSTT to correlate ground test results with flight test results, is planned for 3QFY01. The LFT&E program for lethality against tactical missiles should be complete by the end of FY01.

The LFT&E program also includes the lethality contribution of the steel cylindrical projectiles (lethality enhancers) that are released by the PAC-3 missile in its terminal phase to damage air breathing threat targets such as cruise missiles, fixed-wing and rotary-wing aircraft in case of a near miss. The first test series of 15 shots against plate targets was conducted in February 2000. Test data are being applied to the lethality model used for attack of air breathing targets. The second series of 15 shots against target components is currently unfunded by the project office.

Other T&E Activity

The Force Developmental Test and Experimentation (FDT&E) was conducted White Sands Missile Range in September-November 1999. The FDT&E focused on ensuring that the PAC-3 doctrine, tactics, training, and logistics were appropriate prior to the start of the LUT. The test concept was similar to that used during the LUT, namely, a combination of live-air search and track (twelve missions) plus MFMS exercises (11 scenarios). The results of the FDT&E indicated that there were no significant issues concerning doctrine, tactics, training, or logistics, the main focus of the tests. Demonstration of system reliability was not a primary objective of the FDT&E; however, it was noted that a number of subsystems did not meet the required mean time between critical mission failure rates (although the system did perform somewhat better than in the preceding CDTE-3). For example, the failure rate for the: Engagement Control Station was 2.7 times greater than allocated, and the failure rate for the PAC-3 Launching Station was 1.3 times greater. The Radar Set did exhibit good reliability during FDT&E, with a failure rate 3.8 times smaller than allocated.

A PATRIOT “live-over-simulation” flight test was conducted at White Sands Missile Range on June 1, 2000. A PATRIOT standard production missile successfully engaged an unaugmented MQM-107 drone. The flight test used Configuration-3 hardware and PDB-5 software. The primary objective of this firing was to evaluate system operation during an engagement while the HWIL Fixed Flight Mission Simulator (FFMS) presented a large number of targets for the radar to process, evaluate, and track. Other objectives included demonstration of the ability to launch a standard PATRIOT missile in the presence of other potential targets, and collection of reliability data. This “live-over-simulation” test marked the first time that a PATRIOT missile was fired against a target while the FMS was loading the system with simulated targets.

TEST & EVALUATION ASSESSMENT

ATEC's evaluation of the LUT concluded that notwithstanding the demonstrated improvements in capability, the system, as tested, has problems with target classification, discrimination (major), identification, and track management that limit effectiveness. Additionally ATEC assessed the PAC-3 Configuration-3 Ground Equipment as not operationally suitable. The reliability and maintainability characteristics of the Configuration-3 equipment do not meet the PAC-3 ORD requirement for the mean time between critical mission failure and operational availability. However, the ground equipment is assessed as operationally survivable and as capable of executing its operational missions in a tactical environment. DOT&E has independently evaluated data from the LUT and fully supports the ATEC evaluation.

The LUT revealed a number of PAC-3 system reliability problems. Although the reliability improved between CDTE-3 and the LUT, the Communications Relay Group mean time between critical mission failure (MTBCMF) rate was seven times greater than allocated, and the Engagement Control Station MTBCMF rate was twice as large as allocated. The Radar Set and PAC-3 Launch Station met their MTBCMF rate requirements in the LUT. The Routing Logic Radio Interface Units "hangs" were the primary reasons that the fire unit MTBCMF rate was 1.7 times greater than the requirement. The Routing Logic Radio Interface Units and Data Link Terminals continue to be major contributors to poor system reliability. While some of these reliability problems may have been caused by hardware, most of them are attributed to software. The PM and contractor have prepared a "get well" plan to correct and verify through testing that these problems have been fixed, prior to starting the IOTE on the full-up ground system and new PAC-3 missile.

The LUT FMS trials on the PAC-3 ground system revealed approximately 38 instances of high priority problems with the PDB-5 software. Most notable were instances where the system dropped target tracks, misidentified objects, engaged debris, or did not engage threatening TBMs. Many of these instances involved system boundary issues that occurred in some of the threat scenarios. These problems are being evaluated since these were not software errors that could be fixed. A new PDB-5 software drop occurred at the end of FY00, and a series of FMS "regression tests" of this software began in October 2000 to prove out the changes. The regression tests demonstrated that all priority one and two software problems have been corrected, although lower priority problems still exist. The PM plans a "limited material release" of the ground systems to the field, which would allow the Army to begin upgrading older PAC-3, Configuration-2 systems to the newer PAC-3, Configuration 3 capability at the rate of about three or four systems per year. The ATEC recommendation, which DOT&E supports, is to hold up material release on the PAC-3, Configuration-3, ground system until the problems found in the LUT have been demonstrated corrected. The PAC-3 ground system reliability will be tested during the IOTE.

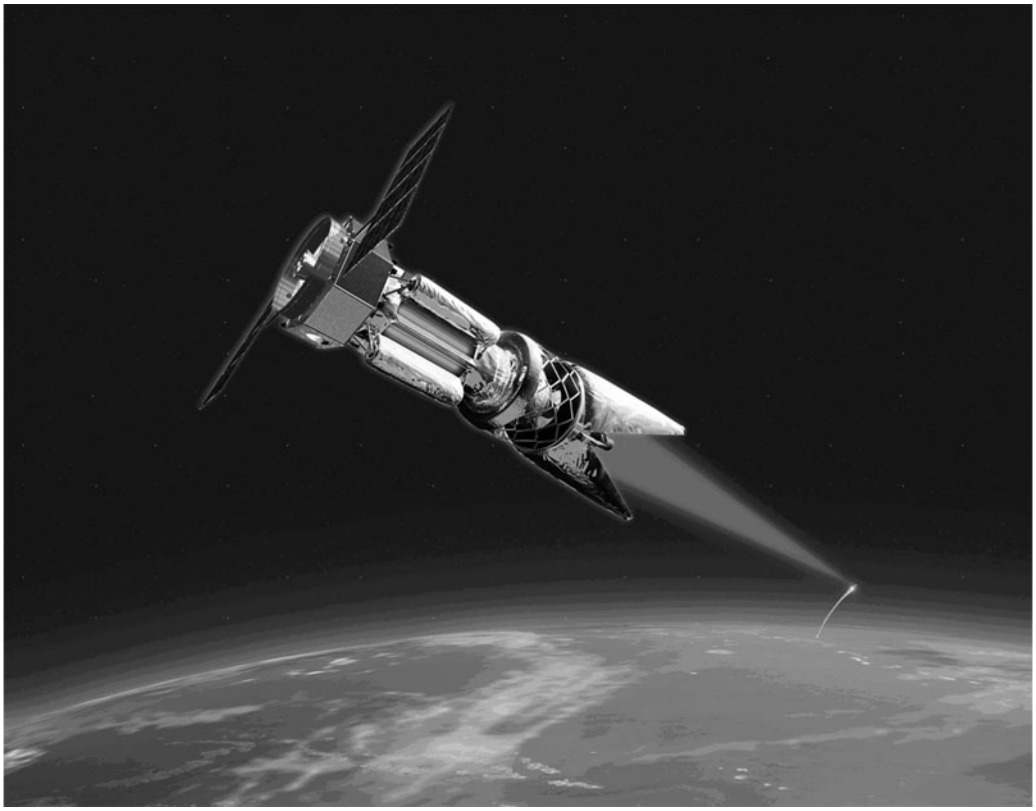
With the completion of the DT-6 intercept test, the PAC-3 missile has completed five successful intercepts against limited threat representative targets. Of all the PAC-3 missiles flown in tests to date, the PAC-3 interceptor flown in the Engage-On-Remote-A (EOR-A) test was the only missile that is considered "production representative." The current TEMP requires production representative missiles throughout the DT and OT flight test program. Slower than expected software development and unexpected hardware problems have resulted in the need to use non-production representative hardware and software in much of the flight test program to date. This, coupled with relocation of the seeker assembly facility from Georgia to Alabama and the need for temporary "white wire" fixes in the seeker circuitry, resulted in testing a missile that is not considered production representative. Using these non-production prototype missiles in testing does not adequately address the suitability and effectiveness issues for the final production missile configuration. At the encouragement of DOTE, BMDO and the Army are restructuring the program to address the production representative issues, among other programmatic concerns.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

The PAC-3 system has achieved six intercepts in six attempts (against four TBM targets and two cruise missile targets). A large part of this success derives from the program office's commitment to mitigate flight test risks by conducting extensive ground testing. For example, DT-6 was originally scheduled to occur at the very end of FY00, but pre-test hardware-in-the-loop testing revealed a potential problem with the tactical PAC-3 missile discrimination software. This problem could have led to the PAC-3 missile engaging the wrong target. The current PAC-3 FY01 schedule includes eight flight tests, each of which is significantly more complex than any previous flight test. Given the success-oriented nature of the PAC-3 flight test matrix, the contractor and project office must strive to ensure that the risk is mitigated through continued maximum use of hardware-in-the-loop, digital models and simulations, and other ground-based tests.

A serious potential problem with the PAC-3 ground system is the reliability shortfalls demonstrated in the CDTE and LUT tests. These reliability problems must be corrected before the ground system is fielded or enters IOT&E. Other PDB-5 software deficiencies revealed in the LUT must be corrected before the system can enter IOT&E.

SPACE BASED LASER (SBL)



BMDO and Air Force Funded Experiment

Total Number of Systems:	1
Total Program Cost (TY$):	$3B
Average Unit Cost (TY$):	N/A
Full-rate production:	N/A

Prime Contractor

Joint Venture: Boeing, Lockheed Martin, and TRW

SYSTEM DESCRIPTION

The Space Based Laser (SBL) is a pre-Milestone 0 research effort for space-based directed energy systems. All efforts and objectives are to be compliant with the Anti-Ballistic Missile Treaty. The SBL's primary mission, if deployed, would be to negate ballistic missiles while they are in their boost phase, which has the advantage of eliminating decoys and may prevent the warhead(s) and/or submunitions from being deployed. The range of the SBL is expected to be thousands of kilometers. Eventually, a constellation of SBL satellites could be deployed providing worldwide coverage. The SBL could be a contributor to a layered, family of systems missile defense.

The laser will be an HF (hydrogen fluoride) chemical laser with multi-megawatt power. The HF laser operates at a wavelength of 2.8 micron. Besides the high-energy laser, the SBL will also have an Acquisition, Tracking, and Pointing (ATP) system to locate and track targets as well as provide information needed to aim the high-energy laser. The SBL will have a beam controller, which will be responsible for pointing the laser (based on data from the ATP system) and for beam quality. The beam director will focus the outgoing high-energy laser on the target.

BACKGROUND INFORMATION

The SBL follows at least a quarter century of research into high-energy laser weapon systems, including a great deal of work done during the 1980s under the Strategic Defense Initiative (SDI). Chemical laser weapons were first demonstrated in the mid-70s (dating back to the Mid-Infrared, Advanced Chemical Laser, also known as MIRACL). More recently, the Alpha program has demonstrated megawatt HF lasers suitable for space deployment. Concurrent progress has also been made with key optics technologies, such as large segmented mirrors developed under the Large Advanced Mirror Program and uncooled optics capable of handling high-energy laser beams.

The SBL Integrated Flight Experiment (IFX) contract was awarded to the Joint Venture team of Boeing, Lockheed Martin, and TRW in February 1999. This contract will include technology maturation, IFX design and development, construction of ground test facilities and the execution of ground tests, and launch and on-orbit testing. The program tentatively plans to launch the IFX space vehicle in FY12 with a three-year mission. Leading up to IFX launch will be a series of integration tests performed on the ground. The culminating event of the SBL IFX is to conduct a lethal demonstration, using a laser in space to destroy a thrusting target.

The Ballistic Missile Defense Organization and the Air Force jointly fund the SBL IFX, with the former paying about 55 percent of the program cost and the Air Force executing the program. Total program cost is expected to be around $3 billion. The current 18-month phase of the program is funded for approximately $125 million. Between now and FY12, technology maturation will continue and design of the laser, beam control, beam director, and spacecraft systems will begin.

Design and construction of the SBL Test Facility (STF) is expected to begin in 2002. The STF will be a large facility that will enclose an entire SBL vehicle and allow testing of the entire system—including the high-energy laser—in an evacuated space environment. The STF is expected to be completed in approximately 2007; at this point, a four-year test period in the STF would begin, leading up to the IFX launch from Cape Canaveral in 2012.

At this time, there are no plans to initiate a formal acquisition program to develop an operational, combat-ready space-based laser weapon system. The SBL IFX is an experimental program. The SBL IFX vehicle will not be a prototype, but it will be used to learn about the engineering challenges and feasibility of developing a space-based weapon system and its potential benefit to missile defense.

TEST & EVALUATION ACTIVITY

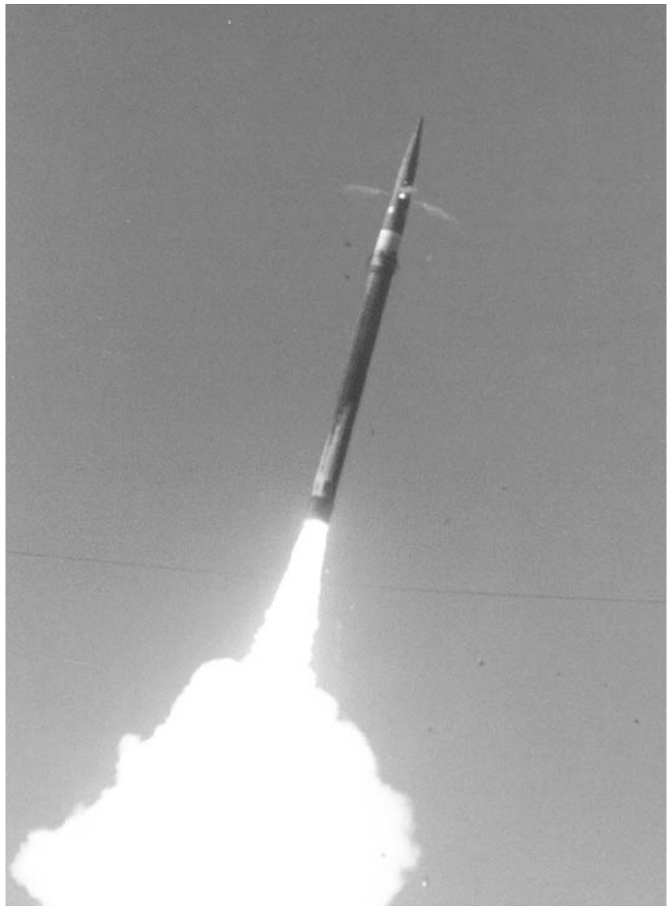
At this early stage in the program, test and evaluation performed under the SBL program has generally been limited to component and sub-system level developmental testing. Besides testing required to develop the actual SBL system, lethality tests have also been conducted. This testing has generally been limited to coupon-level tests, but because the SBL and ABL are laser weapons that negate missiles during the boost phase, the SBL program plans to team with the ABL program to jointly conduct lethality tests in the future. Although testing conducted under the SBL program so far has been developmental in nature, there is a legacy of testing—including both high-energy laser and optics as well as lethality testing—that has been conducted on various programs, including SDI programs and follow-on program such as Alpha.

The STF is currently in the planning stage. Three sites are currently under consideration for hosting this facility: Stennis Space Center (MS), Redstone Center (AL), and Kennedy Space Center (FL). A decision to build the STF at one of these sites is expected in early FY01. Groundbreaking will occur in 2002, and the facility should be completed in 2006. Integration of the laser, beam control, beam director, and spacecraft systems in the STF would then begin, leading up to integrated tests in 2008 or 2009. A period of time is provided in the schedule to incorporate the lessons learned from these tests into the final IFX design, which would be tested in the STF starting in approximately 2010, prior to launch in 2012.

TEST & EVALUATION ASSESSMENT

The STF will be a very large facility, and will support a major test and evaluation undertaking for the SBL. The STF will simulate the space environment with a large, integrated satellite actually operating—including the production of a high-energy laser beam and exhaust gases. The program should be commended for planning such a facility early in the overall Integrated Flight Experiment.

THEATER HIGH ALTITUDE AREA DEFENSE (THAAD)



Army ACAT ID Program

Total Number of Missiles:	1250
Total Program Cost (TY$):	$23,000M (w/O&S costs)
Average Unit Cost (TY$):	BY00--$1.8M
	BY88--$1.3M
Full-rate production:	FY08 (Configuration 1)

Prime Contractor

Lockheed Martin Missiles and Space
Sunnyvale, CA

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Theater High Altitude Area Defense (THAAD) is a mobile ground-based Theater Missile Defense (TMD) system designed to protect forward-deployed military forces, population centers, and civilian assets from Theater Ballistic Missile (TBM) attacks. THAAD negates incoming ballistic missiles utilizing hit-to-kill technology (i.e., kinetic energy) and is capable of intercepting them at either endoatmospheric or exoatmospheric altitudes. As a core element of the Family of Systems layered defense architecture, it provides upper-tier missile defense in concert with the lower-tier systems, PATRIOT Advanced Capability-3 (PAC-3) and Navy Area TMD.

The THAAD system is comprised of the following segments: mobile launchers, interceptors, radars, Battle Management/Command, Control, Communications, and Intelligence (BM/C^3I) units, and ground support equipment. The launcher system is a modified U.S. Army palletized loading system truck, equipped with a missile-round pallet, launcher, electronic controls and communications. The interceptor consists of a single-stage, solid-fuel booster—which employs thrust vector control technology for boost phase steering—and a separating kill vehicle that uses an infrared seeker and divert thrusters for terminal guidance and control. The THAAD radar is a solid-state, X-band, phased-array antenna that performs search, track, threat type classification, and interceptor fire control functions. As the communications link between the BMC^3I and interceptors, the THAAD radar also delivers target updates to the kill vehicle, which are used for mid-course guidance. The THAAD BM/C^3I segment manages and integrates all THAAD components to control the THAAD weapon system. Its major components are the Tactical Operations Station, the Launch Control Station, and the System Support Group. These components can be configured to form a Tactical Station Group, Tactical Operations Center, Sensor System Interface, or a Communications Relay. The Tactical Operations Station and the Launch Control Station are transported on High Mobility Multi-Purpose Wheeled Vehicles; the System Support Group carrier is a production standard 5-ton cargo truck.

THAAD embodies ***Joint Vision 2020's*** operational concepts of ***dominant maneuver***, ***precision engagement***, and ***full-dimensional protection***: THAAD is a mobile, integrated system of elements that provides responsive command and control to locate and engage attacking TBMs. ***Information superiority*** enables THAAD to operate within a communications network, receiving and exchanging data with external sensors, PAC-3, Navy Area, and other theater air and missile defense systems. Furthermore, THAAD is designed to rapidly respond to military crises and, therefore, incorporates the fourth operational concept of ***focused logistics***.

BACKGROUND INFORMATION

The Gulf War demonstrated an immediate need for an effective and dedicated missile defense system capable of countering TBM attacks. Congress recognized this need in the National Missile Defense Act of 1991 and the Defense Appropriations Act of 1991, which established the requirement for a "deployable TMD demonstration system" for forward-deployed U.S. and Allied Forces by the mid 1990s. A mature system with full capabilities was to be developed by the year 2000.

The long-term response to this requirement is the development and eventual deployment of the THAAD "objective" system. The THAAD User Operational Evaluation System (UOES), now terminated, would have been the demonstration system using prototype equipment to perform early operational assessments and deploy in the event of a "national emergency" contingency operation.

Currently, THAAD is planning to meet its ORD requirements through two sequenced configurations, both developed during EMD, employing an "Evolutionary Acquisition" approach. The Configuration 1 system provides a significant warfighting capability while deferring some software (time-intensive) development for the BMC^3I and Radar to Configuration 2. Configuration 1 is intended to meet the seven key performance parameters of threat, range and radar cross-section, defended area, protection effectiveness, lethality, kill probability, and interoperability. The missile design will be matured for Configuration 1. The Configuration 2 system delivers full ORD compliance. Currently, Configuration 1 will enter production in FY09. Configuration 2 upgrades will be available in FY12.

THAAD entered Engineering and Manufacturing Development (EMD) in June 2000. THAAD has an approved TEMP for EMD.

TEST & EVALUATION ACTIVITY

THAAD achieved 'hit-to-kill" target intercepts in Flight Tests 10 and 11 (FT-10 and FT-11). Subsequently, the Department authorized the Army to suspend the Program Definition and Risk Reduction (PDRR) test program and enter the EMD phase. For clarity, this report provides a summary of the THAAD PDRR test program activities.

The PDRR phase of the THAAD program contained no operational testing, however, the Army and OSD Test and Evaluation (T&E) communities participated early in the planning and execution of PDRR developmental testing. A system evaluation using system and element-level PDRR data supported a key program decision to proceed to EMD.

The THAAD PDRR T&E program performed system flight testing, Hardware-In-the-Loop (HWIL) testing, element ground testing and digital simulations. Flight testing was the centerpiece of the T&E program and was conducted at White Sands Missile Range (WSMR). Successful flight tests allowed testers and developers to collect system-level data, assess the kill vehicle's seeker technology and intercept capability, and generate in-flight environmental and "end game" data. These data have led to improvements in the design of system hardware and software, and will also be used to validate models and simulations supporting system evaluations.

The program completed eleven PDRR flight tests, including eight intercept attempts. The first six of eight intercept attempts failed to achieve an intercept; the last two intercept attempts were successful.

PDRR Flight Tests

Flight Test	Date	Intercept	Discussion
FT-1	April 21, 1995	N/A	Propulsion test, no target
FT-2	July 31, 1995	N/A	Kill vehicle controls test, no target
FT-3	October 13, 1995	N/A	Target flyby test
FT-4	December 13, 1995	NO	Software error in avionics led to premature kill vehicle fuel consumption
FT-5	March 22, 1996	NO	Kill vehicle connector to booster failed at separation
FT-6	July 15, 1996	NO	Seeker electronics failure or Dewar contamination led to saturation of one half of focal plane array
FT-7	March 6, 1997	NO	Kill vehicle battery interface connection was contaminated, preventing operation of DACS thrusters
FT-8	May 12, 1998	NO	Electrical short circuit due to foreign object debris in thrust vector control caused booster failure
FT-9	March 29, 1999	NO	Attitude control system nozzle was torn from its bracket
FT-10	June 10, 1999	YES	Intercept of HERA class unitary target within aimpoint region
FT-11	August 2, 1999	YES	Intercept of HERA class separating target within aimpoint region

The Department decided to stop PDRR testing after achieving intercepts in Flight Tests 10 and 11 because significant portions of the THAAD missile will be re-designed for EMD. The early developmental tests in EMD are planned at WSMR and Kwajalein Missile Range (KMR) to prove out the new system re-design prior to committing to the production configuration. The THAAD missile re-design features between PDRR and EMD include:

- New missile mission computer.
- New cylindrical missile canister.
- Elimination of course elevation gimbal gyro.
- New Divert and Attitude Control System fuel tank with 40 percent more fuel, located aft of the divert thrusters.
- Relocation of missile avionics to accommodate center of mass change due to new Divert and Attitude Control System fuel tank.
- Changes in the Divert and Attitude Control System nozzles that increase thrust by 10 percent.
- An improved thrust vector control system on the booster.

Live Fire Test and Evaluation (Lethality). THAAD's PDRR lethality test activities included both Light Gas Gun (LGG) and high speed sled testing. THAAD lethality testing has focused on emerging targets described in the Ballistic Missile Requirements Document and specifically identified in the THAAD System Threat Assessment Report (STAR). In FY98, the Army conducted a series of eight, quarter-scale LGG tests against a heavily ballasted submunition target at the University of Alabama-Huntsville (UAH) LGG facility located on Redstone Arsenal. Those tests showed that THAAD could be lethal against that submunition target under a wide range of conditions. In FY99, another series of four LGG tests against a submunition warhead of similar design, but with a different fill, was conducted. Those tests also showed that THAAD could be lethal against the target under a wide range of conditions. Previously during FY95, the program conducted 15 dynamic sled tests at Holloman AFB, NM, against a static, threat representative target to study THAAD end game lethality. A series of ten quarter-scale LGG tests, conducted at the UAH to obtain lethality information, was completed in October 1996. These lethality tests provide the baseline for planning formal LFT&E for EMD. In 1996, DOT&E approved THAAD's live fire strategy.

In 2000, the THAAD PO and the LFT&E working group refined the approved LFT&E strategy to reflect changes to the threat, knowledge gained from testing to date, and changes to the current programmatic funding and schedule. The LFT&E strategy to be executed during EMD includes full-scale sled tests, sub-scale LGG tests, and simulation analyses using the Parametric Endo-Exoatmospheric Lethality Simulation (PEELS) model and physics-based hydrocode simulations. The evaluation will also employ lethality data from the planned EMD flight tests. The supporting EMD ground tests and analyses for LFT&E are scheduled to begin in FY02 according to the approved TEMP.

TEST & EVALUATION ASSESSMENT

The THAAD program has made significant progress by achieving two hit to kill intercepts with high accuracy. The two intercepts demonstrated limited integrated system performance among the missile, launcher, radar, and BMC^3I segments using scripted scenarios. DOT&E supported the decision to terminate testing on the PDRR missile and focus efforts on developing and testing the EMD missile design intended to improve the reliability, testability, producibility and affordability of the missile.

DOT&E's proposal for early flight testing with the new, "next-generation" missile has been integrated into the THAAD program schedule, first at WSMR--then at KMR. The early flight testing is designed to demonstrate the capability of the new missile design to reliably and accurately intercept "threat representative" ballistic missile targets. Five successful intercepts are planned prior to the Department proceeding with the second limited production buy of the new missile design. The five intercepts will also provide critical data needed to validate the missile fly-out simulation for the re-designed missile. This approach provides an incentive for the contractor and Project Manager to conduct the necessary ground testing to achieve the five intercepts with the minimum number of flight test attempts. The number of flight tests it takes to accomplish the five intercepts will provide an indication of how well the new missile design is performing so that the Department can assess the risk of continuing with the production phase of the program.

Consistent with the report of the HWIL Study Group chartered by BMDO (with DOT&E participation), the THAAD program, with strong DOT&E support, is committing to perform extensive end-to-end HWIL ground testing, including radar, missile, BMC^3I, and launcher components. End-to-end HWIL simulations should include maximum threat loading and high fidelity scene generation of the end game. Additionally, the entire system should be subjected to extreme operating environments to ensure that the system performs anywhere it is deployed.

Problems with the PDRR missile were significant. Subsequent to a THAAD Critical Technical Review in June 1997, DOT&E formally identified to BMDO a number of problem areas including design, product quality/assurance, and testing that needed to be further addressed by the prime contractor. The issues resulted in the THAAD program suspending flight testing for 14 months after FT-07, while the missile the contractor and an independent government team sponsored by the THAAD Project Manager reviewed design, pedigree, product assurance, and testing. During this timeframe DOT&E, BMDO, and DTSE&E also co-sponsored the "Welch Panel" chaired by General Larry Welch (USAF Ret.). The panel included experts from both the public and private sectors. The Welch Panel conducted a comprehensive review of all BMDO acquisition programs for obvious problem areas and deemed the following factors as most relevant to explain the inadequate performance of the THAAD PDRR system:

- The sense of urgency to deploy a UOES resulted in an overly optimistic development schedule. Rather than being event driven—proceeding in development only after technical milestones were met—the program was driven to keep pace with the planned deployment schedule. Schedule forces and budget cuts contributed to deficient manufacturing processes, quality control, product assurance, and ground testing procedures which in turn resulted in poor design, lack of quality, and failed flight tests. The ultimate result, ironically, was a schedule slip of about nine years. The Milestone III decision, initially scheduled in 1991 for FY00, is now expected no earlier than FY08.

- Quality control deficiencies in the manufacturing of the interceptor were a major factor in all but one of the flight test failures. As described above, FT-5, FT-6, FT-7, FT-8, and FT-9 failed because of some relatively low technology, manufacturing defects unrelated to the particular demands of hit-to-kill.

- The integration of high technology hit-to-kill TBM systems with common integration, assembly, test, and quality control processes has proven to be more difficult than previously anticipated. THAAD demonstrated the unique aspects of hit-to-kill technology and produced substantial amounts of in-flight environmental data during all phases of the engagement. These data, together with data collected during HWIL testing of the seeker, indicate that automated image processing performed during the end game is likely to be a major challenge in maturing this technology.

Concurrently, the Project Manager and contractor conducted a thorough examination of its practices. Actions taken to improve pre-flight testing and quality control for all subsequent flight tests included:

- Complete pedigree review of hardware design and maturity at the component and sub-system level.

- More demanding environmental stress screening and flight certification testing.

- HWIL testing of the seeker at the U.S. Army's high fidelity scene generation facility in Huntsville, AL.

At the recommendation of DOT&E, the Project Manager tested the FT-08 seeker's performance in a high fidelity HWIL facility. This represented a significant advancement in understanding the seeker capability for the THAAD program. Pre-flight testing of the seeker was conducted on all remaining PDRR seekers.

The original flight envelope for THAAD was extremely challenging since it required the THAAD missile to intercept targets flying both in the atmosphere and outside the atmosphere. As part of the missile re-design, the requirement for intercepts deep within the atmosphere is being relaxed. The required minimum engagement altitude for THAAD is still endoatmospheric but is raised higher than originally in the PDRR phase. Analyses conducted by the contractor, the PM, and the User show there is no degradation in the THAAD system against "threshold" ORD performance requirements. This means that THAAD must be fielded with a lower tier system (e.g. PAC-3) to provide the near leak-proof protection against all threats in the theater.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

DOT&E's early participation in the PDRR phase of the THAAD program has directly contributed to more comprehensive pre-flight ground testing. The successes of THAAD, PATRIOT PAC-3, the Navy Area Program, and the National Missile Defense programs can be directly traced to robust pre-flight ground testing and analyses.

Stable program funding and guidance is essential for program success—especially for a program as complex as THAAD. Pressures to quickly field a TBMD capability, budget cuts, and program restructuring, combined with the freedom and flexibility allowed by acquisition reform, all strongly influenced programmatic decisions and trade-offs, with schedule as the leading priority. In the end, these decisions led to test failures and delayed the program several years.

Program execution must be event driven rather than schedule driven. Experience shows that event driven programs have the best opportunity of succeeding in the shortest time. The Welch Panel concluded that the THAAD program “rushed to failure” because the program was schedule driven.

In EMD, the THAAD contractor must implement significantly improved component-level engineering design and qualification testing, quality control processes, and product assurance testing procedures in the development and manufacturing of the interceptor. Improved component-level quality testing that confirms both design and reliability will greatly increase confidence that the “EMD” missile will perform as intended.

The THAAD program must perform thorough ground and HWIL testing of the THAAD system, including system end-to-end testing. To support the system end-to-end testing, the THAAD program must incorporate a disciplined modeling and simulation approach for verification, validation, and accreditation; and an extensive design of element and system-level model and simulation use to ensure that adequate data is generated to support integrated test and evaluation.

The THAAD PDRR missiles did not prove to be effective and reliable. Pursuing the PDRR design into EMD is not warranted given the PDRR flight test record, quality control problems, and known design problems. During the PDRR phase of development, THAAD has proven that the hit-to-kill technology and THAAD design are potentially effective against TBM missiles. Now, THAAD must revisit the design to increase its reliability, testability, producibility, and affordability.

DEFENSE JOINT ACCOUNTING SYSTEM (DJAS)

DFAS ACAT IAM Program

Total Number of Systems:	TBD
Total Program Cost (TY$):	$455M
Average Unit Cost (TY$):	TBD
Initial Operational Capability:	TBD
Full Operational Capability:	TBD

Prime Contractor

N/A - DFAS Financial Systems Organization Develops Software

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Defense Joint Accounting System (DJAS) is based upon the Army Corps of Engineers Financial Management System that has been modified and upgraded to ease the transition from legacy systems to a single source, data entry transaction-driven U.S. Standard General Ledger environment. DJAS has been designed to provide a Chief Financial Officers Act capable accounting system that satisfies the Federal Financial Management Requirements and more importantly provides managers and users with timely, relevant, and accurate information for decision making.

DJAS supports specific Army Posts, Camps, and Stations; Army Materiel Command; and Defense Agencies serviced by the DFAS-Indianapolis (DFAS-IN) Center. Contrary to what its name implies, DJAS does not support Navy/Marine Corps or Air Force accounting requirements. DJAS does provide for a wide range of accounting and financial management functions to include (but limited to) funds control, general ledger, accounts receivable, accounts payable, cost management, and reporting. DJAS supports ***Joint Vision 2020*** by providing seamless integration of Army and Defense Agency financial and accounting capabilities. Further, it supports ***information superiority*** by increasing access to financial and accounting information. DJAS is a client-server system designed to run on mid-tier computers located at the Defense Information Systems Agency (DISA) managed computing facilities or local automation offices (in areas not supported by DISA) with user access through the personal computer-based local area networks.

BACKGROUND INFORMATION

DFAS was established in 1991, and was charged to develop a single corporate strategy to support all DoD finance and accounting functions. In 1996, the Under Secretary of Defense (Comptroller) directed the acquisition of a general funds accounting migratory system for specific Army and Defense Agency customers serviced by the DFAS-IN Center. This was part of the DFAS migration strategy for general funds and working capital funds accounting systems as outlined in the "DFAS Accounting Systems Strategic Plan," released in 1997. The initial phase of the migration strategy included the replacement of many existing systems within each Service and Agency with the "best of breed" intermediate solutions. This family of migratory systems would eventually transition to a single Department-wide solution. DJAS is the migratory solution for the specific Army and Defense Agency customers serviced by the DFAS-IN Center.

In addressing the mission needs of the specific Army and Defense agencies customers serviced by DFAS-IN, an Alternative of Analysis (AoA) was completed in November 1997. This AoA considered two feasible Government-Off-The-Shelf candidates, the Corps of Engineers Financial Management System (CEFMS) and the Standard Accounting and Reporting System, and two Commercial-Off-The-Shelf systems, the Integrated Financial Management System developed by Digital Systems Group, Inc. and the Financial Activity Reporting System developed by Computer Data Systems, Inc. That analysis concluded that a re-engineered CEFMS best addressed the mission needs and customer requirements. The DJAS program has upgraded and modernized what was in the CEFMS baseline application to accommodate customer requirements. The DJAS Program Acquisition Strategy calls for incremental prototype testing for its customers. The Ballistic Missile Defense Office in Arlington, VA is the initial DJAS prototype site.

TEST & EVALUATION ACTIVITY

The IOT&E of DJAS, designed to evaluate the initial capability developed for Defense agencies, began in late May 2000. However, during testimony before the Government Reform Subcommittee, the DoD Inspector General criticized the Navy and the Air Force for implementing their own migratory accounting systems, while leaving the Army as the only Service committed to DJAS. This criticism resulted in the House Appropriations Committee Report recommending a FY01 funding reduction to each of the Services and DoD-wide accounts in the Operations and Maintenance Account under the title "DJAS." This report further recommended terminating the DJAS program, citing Clinger-Cohen Act compliance concerns. With the concurrence of the Joint Interoperability Test Command (JITC), the designated OTA, IOT&E was suspended.

TEST & EVALUATION ASSESSMENT

The National Defense Authorization Act for Fiscal Year 2001, released on October 6, 2000, reported that DJAS is not prohibited (terminated). However, the Secretary of Defense may not give a Milestone III decision until a report is submitted to the Committee on Armed Services of the Senate and the Committee on Armed Services of the House of Representatives, addressing a number of programmatic issues such as a single DoD-wide general funds accounting system.

The DJAS PMO is currently revising its acquisition plan to comply with the congressional mandate. DOT&E will work closely with JITC to revise the OT&E strategy to support the revised DJAS acquisition plan.

DEFENSE JOINT MILITARY PAY SYSTEM (DJMS)

DFAS ACAT IAM Program		**Prime Contractor**
Total Number of Systems:	20	N/A - Software Developed by DFAS
Total Program Cost (TY$):	$184M	Central Design Activity
Average Unit Cost (TY$):	$9M	
Full-rate Production (DJMS-AC):	2QFY98	
Full-rate Production (DJMS-RC):	4QFY99	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Defense Joint Military Pay System (DJMS) provides consistent service to its customer base and supports the Office of the Under Secretary of Defense for Personnel and Readiness by consolidating pay management functions. DJMS supports ***Joint Vision 2020*** by providing seamless integration of Service pay capabilities. Further, it supports ***information superiority*** by increasing access to military pay information.

The fielded DJMS consists of client-server terminals and local area networks that provide input to the Defense Finance and Accounting Service (DFAS) central sites. DJMS software has been and continues to be developed within DFAS through the Central Design Activity. DJMS data is sensitive but unclassified. DJMS was developed to prevent unauthorized access, modification, destruction, and disclosure of information to unauthorized users. DJMS applies controlled access protection of Class C2, as set forth in DoD Standard 5200.28.

BACKGROUND INFORMATION

DFAS operates military pay functions at central sites in Indianapolis, Cleveland, and Denver for the Army, Navy, and Air Force. DFAS consolidated the Army, Navy, and Air Force military pay management functions within DJMS. Marine Corps' Active and Reserve military pay accounts are handled in the standalone Marine Corps Total Force System (MCTFS), implemented in December 1994. The Marine Corps' pay accounts will not be folded into DJMS because MCTFS already features a combined pay and personnel system.

DJMS is currently in operation at 100 Army sites, 80 Air Force sites, 60 Navy sites, and 3 DFAS centers. A total of 2.2 million military pay accounts, like the types shown below, have been converted to DJMS-Active Component (DJMS-AC) and DJMS-Reserve Component (DJMS-RC):

Account Type	Implementation Date
U.S. Air Force Active, Air Force Reserve, and Air Force Health Professional Incentive Program	October 1991
U.S. Army Active	April 1992
U.S. Air Force Academy	January 1993
U.S. Army Reserve	July 1993
U.S. West Point Academy	April 1994
U.S. Army Health Professional Incentive Program and Army Reserve Officer Training Corps	April 1995
U.S. Naval Academy	October 1995
U.S. Air Force Officer Training Corps and Navy Health Professional Incentive Program	April 1996
U.S. Navy Reserve Officer Training Corps	August 1996
U.S. Army Junior Reserve Officer Training Corps	October 1996
U.S. Navy Active	February 1998
U.S. Navy Reserve	August 1999

In compliance with the TEMP approved by DOT&E on October 3, 1997, DJMS completed its first OPEVAL in December 1997. This OPEVAL only addressed the DJMS implementation for the Active Navy accounts, since DJMS had already completed its implementations for the Army and Air Force activities.

As a result of the OPEVAL, DJMS for the Active Navy was determined to be operationally effective, pending revision of the operating instructions. However, the system was found operationally unsuitable due to documentation and training deficiencies. The shortcomings in training were considered a Bureau of Naval Personnel problem and not a fault of the DJMS program. DJMS-AC achieved the Major Automated Information Systems Review Council approval for fielding in February 1998.

TEST & EVALUATION ACTIVITY

The plan for OPTEVFOR to conduct OPEVAL for the DJMS-RC in November 1998 was disapproved by DOT&E. The OPEVAL plan was disapproved since the DJMS-RC System Acceptance Testing (SAT), a form of DT, was not scheduled for completion until February 1999. DOT&E directed that OPEVAL should not commence until the SAT has been completed.

In May 1999, after the completion of the SAT, OPEVAL of DJMS-RC was conducted in compliance with the DOT&E-approved TEMP dated April 19, 1999. OPTEVFOR collected test data at four Navy Reserve sites located in Minneapolis, MN; Belle Chase, LA; Mobile, AL; and Atlanta, GA, to allow a variety of technology and telecommunications options to be exercised and evaluated. During OPEVAL, pay transactions normally submitted to the Navy Reserve legacy systems were duplicated and submitted to the DJMS-RC for processing and verification.

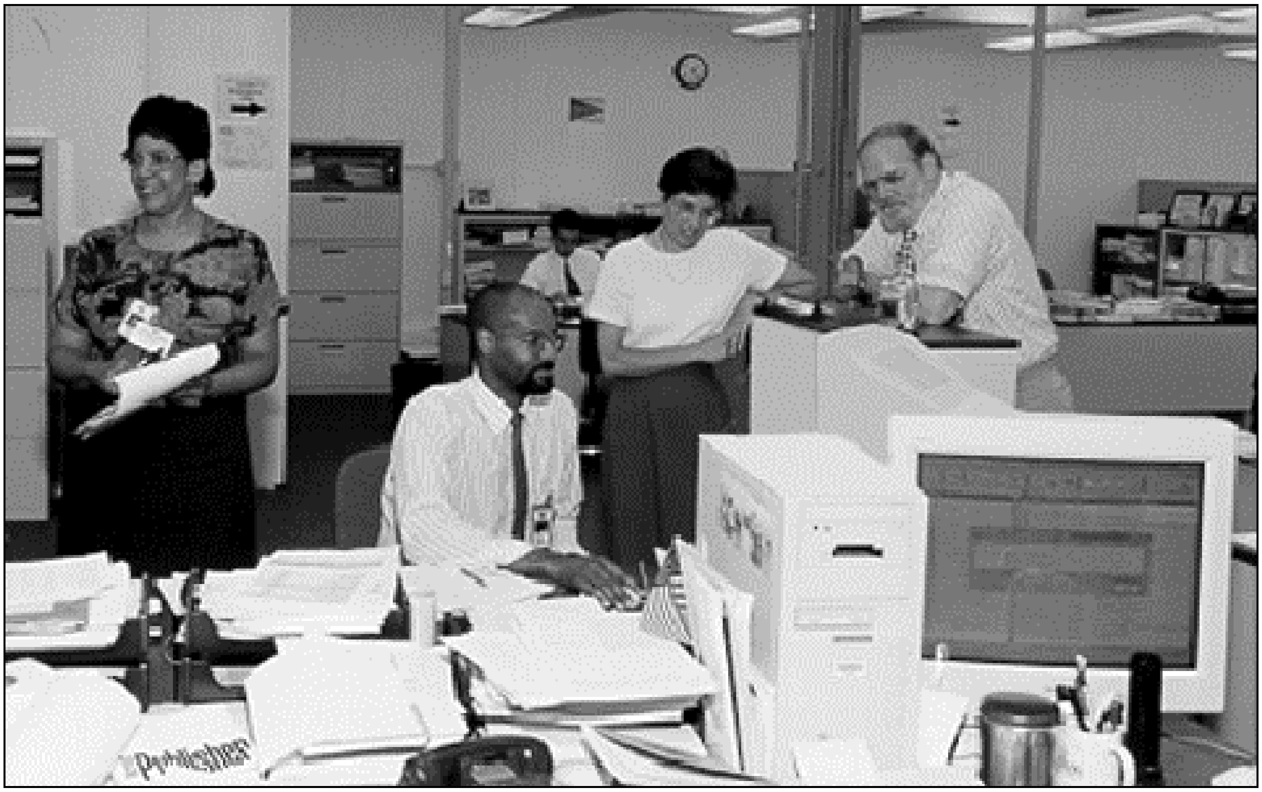
No OT&E was planned or conducted in FY00. DJMS is planned to be replaced or subsumed by the Defense Integrated Military Human Resources System.

TEST & EVALUATION ASSESSMENT

During OPEVAL, deficiencies in processing DJMS-RC error codes and aviator career incentive pay were identified. These deficiencies were attributed to the Navy interface systems and were not related to the DJMS-RC system. After the Navy Reserve Information Systems Office rectified the deficiencies in early June, OPTEVFOR conducted additional testing to verify the fixes. Test results showed that all previously identified deficiencies were successfully rectified. In June 1999, COMOPTEVFOR declared that DJMS-RC was operationally effective and operationally suitable, and recommended DJMS-RC for fleet introduction.

DOT&E concurred with COMOPTEVFOR's recommendation and directed that security and maintainability reviews be completed following DJMS-RC's relocation to the Defense MegaCenter in Mechanicsburg, PA. (During the OPEVAL, DJMS-RC was operating at the Defense MegaCenter in Chambersburg, PA). Further, DOT&E directed that the data bases of DJMS-RC and Navy interface systems be refreshed daily to minimize record disparities and transaction rejections. Based on DOT&E recommendation and input from other OSD oversight offices, the DoD Deputy Chief Information Officer granted DJMS-RC Milestone III approval on August 11, 1999.

DEFENSE PROCUREMENT PAYMENT SYSTEM (DPPS)



<u>DFAS ACAT IAM Program</u>

Total Number of Systems:	1
Total Program Cost (TY$):	$152M
Average Unit Cost (TY$):	$152M
Initial Operating Capability:	4QFY01

<u>Prime Contractor</u>

Oracle (Prime)/Price Waterhouse Coopers

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Defense Procurement Payment System (DPPS) will become the standard DoD procurement payment system used to calculate contract and vendor payments, grants, and other agreement entitlements. It will also be the standard system for generating procurement entitlement information used by accounting, disbursing, procurement, and other systems. All DoD contract and vendor payment legacy systems will be consolidated into DPPS.

DPPS supports DoD contract and vendor entitlement functions through commercially derived applications software designed to operate in an open systems environment. DPPS will be implemented on Oracle Financials with four tiers. *Tier One* is a thin client component acting primarily as the presentation layer. *Tier Two* is a web server supporting navigation via the web and workload balancing. *Tier Three* is an application server containing the bulk of the application logic. *Tier Four* is a data base server. DPPS will use the DFAS Enterprise Local Area Network. End-user hardware must be compliant with DFAS standards, which are consistent with the Defense Information Infrastructure Common Operating Environment.

DPPS supports ***Joint Vision 2020*** by providing effective coordination and consolidation of the DoD contract and vendor payment systems, increasing the effectiveness of DoD financial and accounting management activities. Further, DPPS supports ***information superiority*** by increasing access to DoD procurement payment information.

BACKGROUND INFORMATION

The current contract and vendor payment environment is comprised of many systems that were not designed to share data or manage information from a DoD corporate perspective. Inefficiencies inherent in the operation of many semi-independent efforts have increased costs, caused major resource issues, unmatched disbursements, and focused attention on erroneous contract payments. The DPPS program was chartered to correct these and other shortcomings in procurement payment systems in 1995; and the Mission Needs Statement was approved in the same year. The DoD Comptroller reaffirmed the Mission Needs Statement in February 1997. The Operational Requirements Document was approved by DFAS in December 1997.

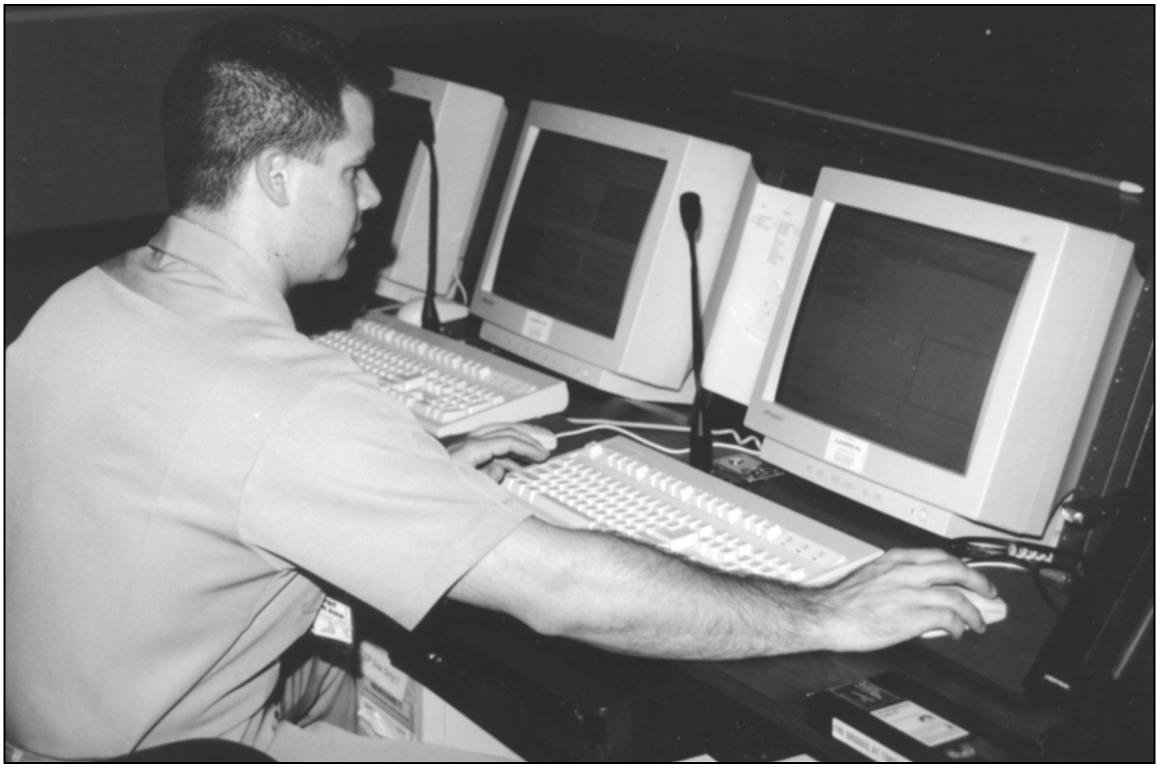
TEST & EVALUATION ACTIVITY

No operational testing is expected until 3QFY01. A draft TEMP is in staffing.

TEST & EVALUATION ASSESSMENT

The Joint Interoperability Test Command will conduct the operational testing of DPPS. The test will focus on the areas of data accuracy, interoperability, system performance, and usability. Furthermore, OT&E will thoroughly evaluate the training and data conversion (from the many data bases being consolidated into DPPS) areas that are considered high-risk and critical to the success of the program.

DEFENSE MESSAGE SYSTEM (DMS)



DISA ACAT IAM Program		**Prime Contractor**
Total Number of Systems:	700+ sites	Lockheed Martin Federal Systems
Total Program Cost (TY$):	$409M	
Life-Cycle Cost (TY$):	$5B	
Full-rate production:	2QFY98	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Defense Message System (DMS) contributes to ***information superiority*** and ***interoperability*** to achieve ***Joint Vision 2020*** by enabling anyone in DoD to exchange messages with anyone else in DoD using a secure, accountable, and reliable writer-to-reader messaging system. ***Full dimensional protection*** is provided by the National Security Agency's Multi-level Information System Security Initiative technology, employing Fortezza cards for personnel identification and encryption services and other Information Assurance protections. DMS must also provide ordinary e-mail ("individual" messaging) by handling both commercial and classified messages. DMS is intended to reduce the cost and manpower demands of the legacy "organizational" messaging system based on 1960s technology—the Automatic Digital Network (AUTODIN). To replace AUTODIN, DMS must be implemented in over 40,000 organizations at over 700 sites worldwide and support message exchanges with tactical forces, allies, other federal government users, and defense contractors. By employing the latest commercial technology, supporting Allied Communications Publications (ACP) 120, and operating on Defense Information Infrastructure (DII) computers and communications backbone, the DMS program will ensure *innovation.* While today's security needs require using the international X.400 messaging standard and X.500 directory services standard, the DMS program anticipates development of adequate security and military features to be implemented in the more common Internet e-mail standards.

BACKGROUND INFORMATION

The Defense Information Systems Agency began the DMS program in 1989. By 1992, the Office of the Assistant Secretary of Defense for Command, Control, Communications, and Intelligence issued a policy mandating the transition to, and use of, DMS compliant systems. In March 1995, additional policy guidance imposed a moratorium on the acquisition of non-DMS compliant electronic messaging systems. Since the August 1997 IOT&E of release 1.0, DMS has continued to improve through two Operational Assessments (OA) in 1998 and 1999. AUTODIN has been steadily downsized to a few message centers called DMS Transition Hubs (DTHs). An OT&E of DMS Release 2.1 showed marked improvement, with all five functional COIs resolved satisfactorily. The security COI was not resolved satisfactorily because Information Warfare penetration testing revealed security deficiencies. DOT&E's independent assessment found DMS 2.1 to be not operationally suitable because a typical system administrator was poorly equipped to install, maintain, troubleshoot, and ensure security configuration of the system. DMS 2.2 consolidates many system upgrades and fixes and introduces an Automated Message Handling System (AMHS) capability necessary for CINC implementation of DMS messaging. Full implementation of DMS requires replacing AUTODIN, supporting ACP 120 message standards, and implementing tactical and intelligence elements through Service and agency programs. These efforts will take several years, involving additional DMS releases and operational tests. For the interim, DTHs support the residual AUTODIN traffic for strategic and some other critical missions.

TEST & EVALUATION ACTIVITY

In spring 2000, the Air Force Information Warfare Center conducted security tests on site-level DMS configurations and the Regional Node and Operations and Security Center (RNOSC) in Columbus, OH. In the fall 2000, the Joint Interoperability Test Command led a multi-Service test team conducting an OA of DMS 2.2, with a Quicklook briefing on December 13. The next scheduled release, DMS 3.0, is supposed to implement the ACP 120 standard that requires interdependent modifications to most DMS components. DMS 3.0 will require a full OT&E.

TEST & EVALUATION ASSESSMENT

The spring follow up security tests again revealed that site system administrators had failed to protect all elements, and that the RNOSC had a vulnerable directory server which could be exploited to conduct a system-wide denial of service attack. During the DMS 2.2 OA, security testers again penetrated each of the five test sites, the RNOSC, and other infrastructure nodes. Weak passwords, clear-text scripts/files with sensitive information, and lax procedures continued to cause most vulnerabilities. RNOSC security is hampered by lack of a firewall. Windows environments within a site domain rely on trust relationships across that domain, and thus the DMS environment is dependent on the level of security maintained in other systems operating within the same domain as DMS. Several penetrations into the DMS platforms were achieved by exploiting these trust relationships.

For the OA of DMS 2.2, a DMS-interface was required to be installed for the AMHS. Several configuration issues were discovered and modifications were implemented immediately prior to the OA. The Norfolk site completed a major re-design just prior to the OA. Other configuration problems were discovered either late in the preparation of the OA, or after OA start. A security patch installed in the mail list agents induced failure in that product. Messaging between DMS and legacy and Allied users suffered due to missing routing information and procedural problems at the Ft. Detrick DTH. Errors in implementing important change notifications are indicative of system immaturity and lack of attention to detail by system administrators. This is exacerbated by documentation complexity and reliance on manual processes. While configuration errors caused many problems, the difficulty and delay in finding and fixing problems is a more serious concern. System administrators were not sufficiently skilled or equipped for troubleshooting, or capturing and forwarding information for further diagnosis by the Help Desk system. At the time of this publication, DMS 2.2 is currently assessed as not operationally effective and not suitable. However, the PM has implemented a plan to resolve the issues found in the OA, and upon resolution, DMS 2.2 will undergo follow-on operational assessment during 2QFY01.

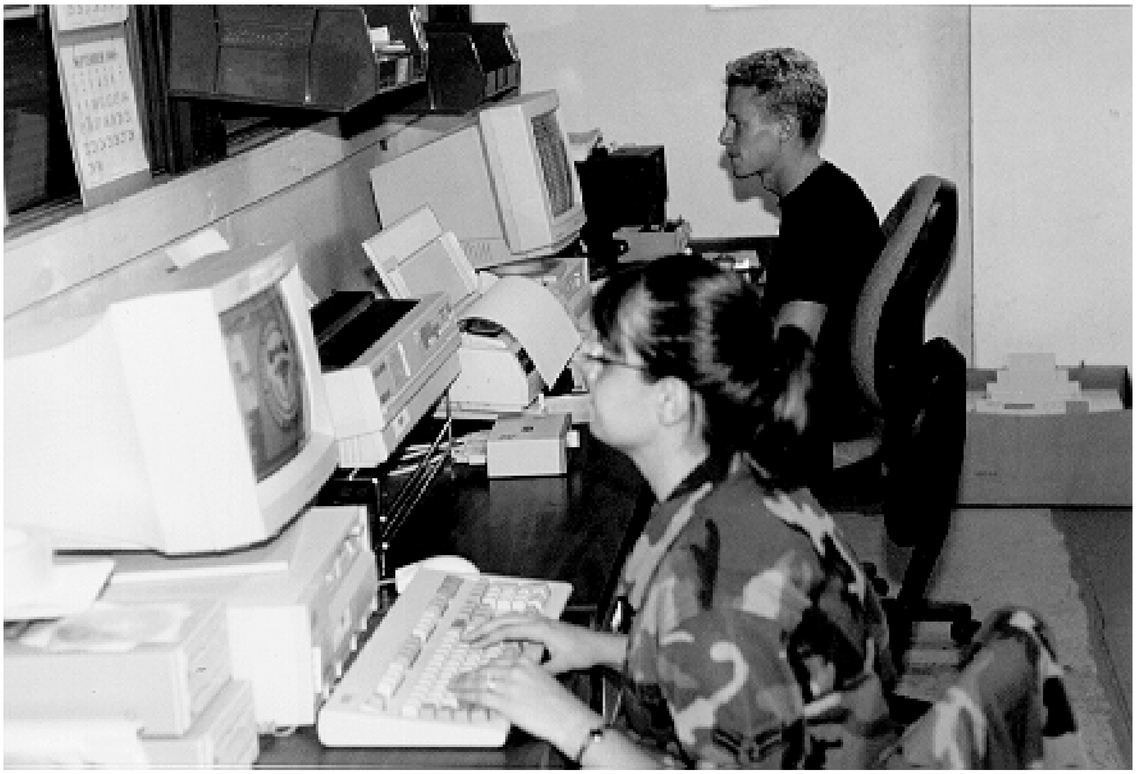
CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

The DII is outside of the scope of the DMS program's control and remains a source of performance uncertainty. Published analyses of the traffic fluctuations of the worldwide Internet suggest that the military DII Internets will also experience severe variability and outages, which no one currently knows how to manage or prevent. These prospects call for broader, more integrated operational tests with embedded security evaluations to evaluate the DII and all of the interoperable systems it supports. Advanced forms of modeling appropriate for representing Internet traffic should also be applied to assessments of DMS and the DII under wartime stresses.

The DMS commercial competition acquisition strategy leads to a proliferation of computer platforms and operating systems, and complicates testing and implementation. Military-unique features, such as strong security protection and non-deniability of message receipt, require modifications of commercial software. Rapidly changing commercial practices require that DMS remain current through frequent modifications. Operational test measures revealed most of these effects of complexity, as most sites became operational with 40 percent of user-accounts being implemented.

The ability to harden the DMS in laboratory shows that repeated failures to fix security vulnerabilities at fielded sites is mostly a result of the inability of local administrators to check whether they have achieved or otherwise compromised a secure posture. This suggests a combined need for better security training, more discipline and attention to detail, command focus, and better automated tools to help assess the overall system security configuration. As DMS extends below the joint level into tactical, allied, intelligence, strategic, diplomatic, and other applications, the security overhead burden becomes ever more difficult and error prone. In the tactical environment, managing a Public Key Infrastructure that requires updating every 56 days is challenging. Demands for security by intelligence organizations, or reliability by strategic organizations, challenge the compromises necessary to stay current with commercial technology. High-assurance guards for passing messages between adjacent security levels can be tailored to local organizational needs, but local security policies may not be adequate for other programs or organizations sharing the same networks. For these and similar reasons, DMS is evolving a complex set of operational and security practices that will be difficult to teach, and for which combinations of conditions will be difficult to anticipate and test. The complexity of installing DMS and maintaining DMS configurations is error prone and requires attention to detail. Operational tests only marginally exercise these tasks, and automated tools under development were not ready for DMS 2.2. This OA was especially valuable in demonstrating the importance of training, procedures, and automated tools for system administrators. The diversity of site configurations and operational needs, combined with technology upgrades, pose design and testing challenges. We recommend intensive development and OT&E of these critical tools and procedures.

GLOBAL COMBAT AND SUPPORT SYSTEM (GCSS)



DISA ACAT IAM Program		**Prime Contractor**
Total Number of Systems:	50 sites	DISA Defense Enterprise Integration Services
Total Program Cost (TY$):	$310M	
Life-Cycle Cost (TY$):	$57M	
Full-rate production:	1QFY01	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Global Combat Support System (GCSS) contributes to ***decision superiority*** and ***focused logistics*** in ***Joint Vision 2020*** by providing top-level commanders and planners current integrated logistics and combat support information from either their workstation web browser (GCSS-Portal) or via a drill-down tool within the Common Operating Picture, Combat Support Enhanced (COP-CSE) display. It supports *interoperability* by accessing key data bases: Joint Total Asset Visibility (JTAV), Global Transportation Network (GTN), Global Status of Resources and Training System (GSORTS), Joint Operational Planning and Execution System (JOPES), and Units, Sites, Tracks Data Store (USTDS) extract from the National Imagery and Mapping Agency (NIMA). GCSS servers employ coded queries to retrieve data as needed from the source data bases, but they neither store nor alter the source data. GCSS taps commercial *innovation* by employing commercial standards and software, and by riding on the Common Operating Environment, which has become the server level of the Defense Information Infrastructure (DII). The DII itself employs Internet technology communications of the Secret Internet Protocol Router Network (SIPRNET).

BACKGROUND INFORMATION

For over a year, several components at Pacific Command (PACOM) have been using a demonstration suite of GCSS. Although the prototype system has not yet been fielded as an integrated element of the Global Command and Control System (GCCS), it has been able to access the true source data bases directly over the SIPRNET to support tests and exercises. This year's OT&E of GCSS v2.0 was to assist the Joint Staff, J-4, in deciding how and whether to field GCSS. The fielding would place GCSS servers under Defense Information Systems Agency (DISA) management at four CINCs, while users would access GCSS information via COP-CSE and GCSS-Portal installed on their workstations within the GCCS environment.

Future versions of GCSS will have terminals outside GCCS and employ some Sensitive But Unclassified information exchanges over the Not Classified Internet Protocol Network (NIPRNET). Since initial user access to GCSS was to be entirely within the GCCS suite at each CINC, the GCSS TEMP for GCSS v2.0 was developed and approved as an Annex to the Capstone GCCS TEMP. Next year, a standalone GCSS Capstone TEMP will be written for the more independent future versions.

TEST & EVALUATION ACTIVITY

The first phase of OT&E was conducted at four PACOM locations: US Pacific Fleet, U.S. Marine Forces Pacific, U.S. Air Force Pacific, and U.S. Army Pacific Headquarters. Although OT&E was conducted on prototype GCSS systems on a shadow GCCS network, the test team observed GCSS being reinstalled as if for the first time and also observed the training of the ten users, most of whom were new to GCSS. A second phase of OT&E will be conducted at the next CONUS CINC to install GCSS. This phase will be conducted on a fully operational network with GCSS loaded as a mission application on operational GCCS systems. When complete, OT&E will evaluate operational effectiveness and suitability based on mission performance, interoperability, security, and mission support and supportability, which include usability and sustainment.

The Joint Interoperability Test Command first observed and verified installation and then conducted the functional portion of the OT&E of GCSS from September 27-October 5, 2000. Following the functional testing, the Joint Staff, J6K, and National Security Agency conducted the Security Test and Evaluation (ST&E) part of OT&E from October 4-18. For the functional testing, users employed GCCS to display facilities and deployments and to answer logistics questions with GCSS queries. In order to verify that the information presented to its users by GCSS agreed with that in the authoritative source data bases, Subject Matter Experts (SMEs) retrieved the comparable information directly from those data bases. Tests for continuity of operations consisted of disabling the connection to the GTN data base and shutting down the GCSS server. Numerous test deviations occurred. The most significant deviation was the last minute inclusion of more representative, less capable workstations, some of which were located in the GCCS environment to validate the ST&E test configuration.

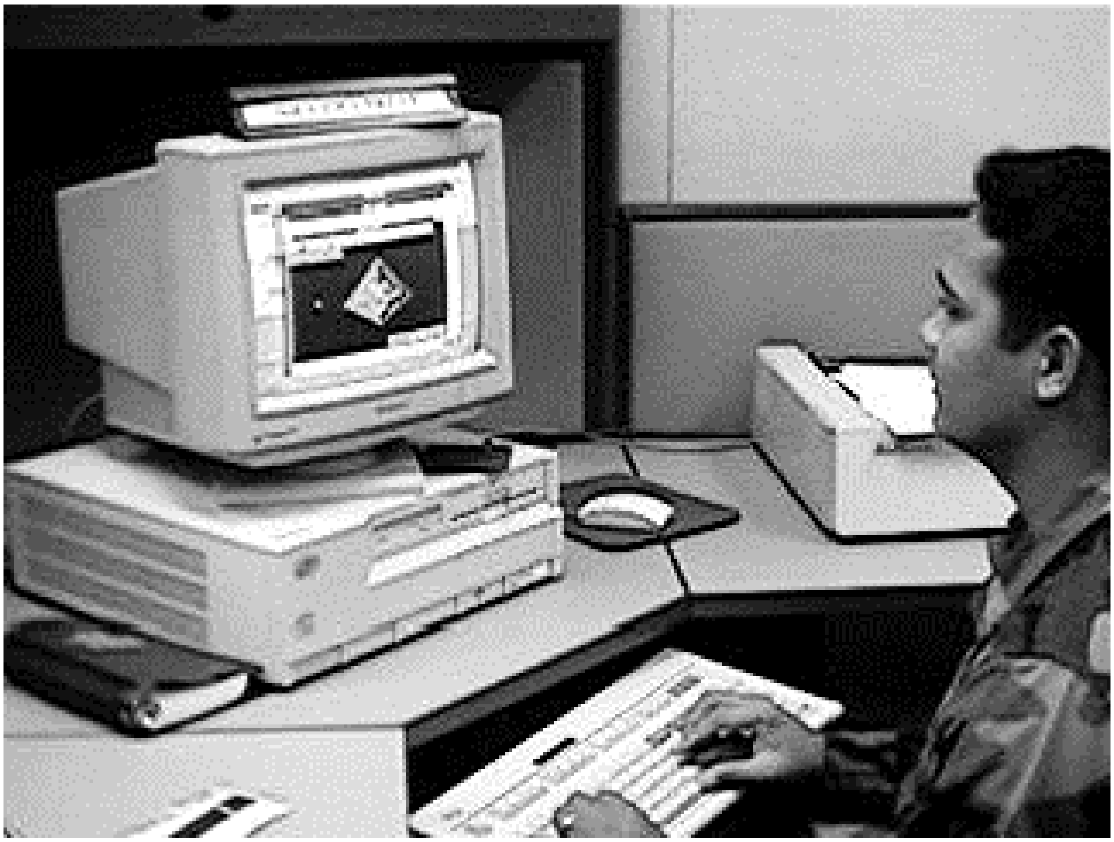
TEST & EVALUATION ASSESSMENT

This first phase of OT&E proved insufficient to evaluate operational effectiveness or suitability. The security testing revealed discrepancies in the installed GCSS configuration and significant security vulnerabilities for GCSS and its source data bases. Before the test, the test team was concerned that the beta site users would be overly experienced, but the opposite occurred. According to survey comments and observed difficulties in querying GCSS, the limited four-hour training sessions were inadequate for most GCSS users. During the test, users had high confidence on less than 75 percent for GCSS-Portal trials and only 65 percent of the COP-CSE trials. In most of the low confidence trials, users got no information back from GCSS. Even the most experienced users had little confidence in 20 percent of their results. Less than half of the users preferred GCSS to their current methods, found it useful, or would use it on a daily basis if available. Because of the complexity of the conditions placed on queries, such as time ranges, the SMEs retrieved usable comparison information for less than one-quarter of the queries coded into GCSS. This small sample could not assure that 95 percent of the queries were error free with 80 percent confidence. Moreover, one of the two significant Test Incident Reports revealed a programming error in a coded query. While users could report problems to the help desk and GCSS recovered within two hours, which is satisfactory for GCSS, help procedures should be streamlined and rely more on local GCSS system administrators.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

Although the first phase of OT&E was inconclusive, it did not reveal any technical reason that GCSS 2.0 should not be installed at another test site for the second phase of OT&E. Security protections, configuration control, and installation procedures must be improved before re-testing security or performing the second phase of OT&E. To evaluate GCSS performance, testers must know how sites expect GCSS to conduct their missions. For example, testers must know whether only specialists and experts are to use GCSS and, since the data bases themselves are known to be imperfect, whether GCSS is only intended to give preliminary results that will be verified by other means. Once the intended users are identified and their missions are understood, training for the second phase must be specific to the user tasks and in sufficient depth to determine whether typical users can select the proper queries and properly execute them for their intended tasks. The user procedures and coded queries should also be reviewed for clarity and accuracy, and any problems should be assessed for their operational impact.

GLOBAL COMMAND AND CONTROL SYSTEM (GCCS)



DISA ACAT IAM Program

Total Number of Systems:	600 sites
Total Program Cost (TY$):	$670M
Life-Cycle Cost (TY$):	$3B
Full-rate production:	4QFY96

Prime Contractor

Science Applications International Corp. (SAIC)

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Global Command and Control System (GCCS) is the central command and control system for achieving ***decision superiority*** in ***Joint Vision 2020*** by providing the top-level infrastructure for automated support to command and control operations worldwide. It is an integrated, reliable, and secure command and control system providing seamless battlespace awareness and a fused battlespace picture by exchanging data, imagery, intelligence, status of forces, and planning information. It supports *interoperability* by linking the National Command Authority down to the Joint Task Force and Component Commanders and Service-unique systems at lower levels of command. It supports *innovation* through an adaptable and constantly improving client-server architecture using commercial software and hardware, open systems standards, office automation, government developed military planning software, and worldwide web technology. GCCS mission applications ride on this Common Operating Environment, which has become the server level of the Defense Information Infrastructure (DII), which also employs Internet technology communications of the Secret Internet Protocol Router

Network (SIPRNET). A top secret GCCS network embedded within the SIPRNET supports close-hold planning and dial-in access supports remote users.

BACKGROUND INFORMATION

After the first OT&E of GCCS, the Joint Staff, J-3, officially declared it the System of Record on August 30, 1996, and simultaneously shut down the legacy system, the World Wide Military Command and Control System (WWMCCS). In 1997, following two months of repeated operational assessments, the Joint Staff declared the top secret GCCS(T) the System of Record to replace the final legacy portion of WWMCCS—the Top Secret Support System. In 1998, the out-of-date commercial operating systems and data base support systems of GCCS v2.2.2 were replaced with GCCS v3.0 Stage I. Such a major change required a full OT&E and provided an opportunity to baseline some functional performance characteristics. Test planning paralleled the development of an Evolutionary Phase Implementation Plan (EPIP) and companion Capstone TEMP finalized in January 1999. These documents describe an innovative and successful new acquisition approach for rapidly integrating mature commercial software or demonstrated applications. Worldwide, CINCs have gained an appreciation for the value of participating in the OT&E process for GCCS because several volunteered to provide test sites in order to gain early knowledge and understanding of the new GCCS v3.0. The OT&E showed that GCCS v3.0, Stage I, could be successfully installed at all sites, could successfully support the great majority of its mission and sustainment tasks, and could be approved as secure to operate. However, the test also uncovered serious shortfalls that were fixed and verified before the Joint Staff, J-3, declared GCCS v3.0 the System of Record in summer 1998. Much of the early effort in 1999 was Y2K testing of the entire GCCS. Later in 1999, the operational tester, the Joint Interoperability Test Command of the Defense Information Systems Agency, assessed a series of Stage II user-software applications to be integrated with GCCS v3.0. Some of these applications did not meet their broad requirements during their OA. For example, the Joint Force Requirements Generator II (JFRG II) intended to assist the forward user in planning activities proved to be user unfriendly, unstable, slow, and lacking important query capabilities. Nevertheless, it has been fielded to selected sites waiting to be further upgraded and distributed more widely when funding permits.

TEST & EVALUATION ACTIVITY

Operational test planning continued for the next major upgrade, GCCS, v4.0, which includes the Joint Operations Planning and Execution System 2000 (JOPES 2000). Since JOPES 2000 modernizes the entire technical implementation of the current planning software and data architecture, a full-up OT&E is required. A new Evolutionary Acquisition Strategy (EAS) and EPIP Phase III are in their final stages of review for GCCS, v4.0. A TEMP revision will be prepared before the OT&E. The Program Office is commended for taking a deliberative, event driven approach to this planning and development effort. They, along with the Joint Staff, J-3, have been instrumental in pulling together a previously contentious community—focusing them into a systematic and thoughtful developmental process.

TEST & EVALUATION ASSESSMENT

Planning for an OT&E of GCCS, v4.0, surfaced several important testing issues. Since previous versions of JOPES have had problems with data synchronization, integrity, and ready access, JOPES 2000 will reduce the number of master data bases and employ more proven distributed data base architecture. At issue is the ability to effectively determine whether this new data architecture fixes the past problems. A second issue is how to test and evaluate the three-level help process that first supports users in day-to-day operation, then assists system administrators, and finally, tracks the fixes of software and documentation deficiencies. This help process is more complex and interactive than even the operations themselves. If this three-level process is responsive to users and provides training, workarounds, and verified fixes on a reasonable schedule, GCCS could quickly adapt to many near-term needs.

The GCCS open-system client-server architecture permits rapid integration of new user applications. A streamlined EPIP acquisition process in which users can nominate mature demonstrations or commercial software for rapid integration into GCCS compliments this technical capability. Testable requirements and performance criteria are developed from the mature software packages by the proponent user organization Subject Matter Expert (SME), who uses his/her military experience and judgment to support integration and refinement. Therefore, SME decisions should be captured in a systemic manner and reviewed as representative of all GCCS users. Otherwise, operational testers will lack the basis for test planning and evaluation.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

Since GCCS depends upon the computers and communications support of the DII, OT&E is always limited by the assumption that under wartime stress the DII will remain available, manageable with current staffing of system administrators, and secure against a broad Information Warfare threat. Recent analyses of the worldwide Internet show that it exhibits traffic variability and outages that no one yet knows how to manage; the SIPRNET based on the same technology should suffer similar interruptions. We recommend that a supportability test of the DII/SIPRNET be conducted that involves all systems under acquisition oversight, while all their interoperable systems are exercised at levels simulating wartime conditions. The principal acquisition systems are GCCS, the Defense Message System (DMS), the Global Combat Support System (GCSS), and the Theater Battle Management Core System (TBMCS). The test focus is their ability to withstand Information Warfare attack and handle stress. Modeling might be necessary to take into account feeder interactions that cannot be played.

GCCS users, developers, and testers have established a unique process to evaluate and correct each GCCS version according to broad requirements and military judgment provided by the worldwide user community. A GCCS EAS, EPIP and TEMP document this process. At its core is continual user involvement. The Joint Staff, J-33, is the user representative who assesses the value and risk of candidate increments to GCCS, coordinates SMEs from the CINCs to assist the assessment process, and declares an increment part of the System of Record based on successful OT. Operational testing itself is tailored to the risks of fielding each increment, and all parties recognize the value added from testing as shown by CINCs volunteering as test sites. As mentioned above, this process must continue to be refined as GCCS continues to modernize and add unique and novel capabilities by such efforts as functional analysis to assist SMEs and combined DT/OT leading up to OT&E.

BUSINESS SYSTEMS MODERNIZATION (BSM)

DLA ACAT IAM Program

Total Number of Systems:	1
Total Program Cost (TY$):	$390M
Average Unit Cost (TY$):	$390M
Initial Operating Capability:	FY02
Full Operating Capability:	FY05

Prime Contractor

Andersen Consulting

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Business Systems Modernization (BSM) is an across-the-board improvement and upgrade program for Defense Logistics Agency (DLA) operations. Central to the objective of the BSM program is the evolution of DLA's business practices to emulate best current commercial practices and the transformation of DLA from a manager of inventory to a broker of information.

DLA is a logistics combat support agency whose primary responsibility is to provide supplies and services to America's military forces worldwide. DLA's missions include the management of over 4 million consumable items and the processing of more than 30 million annual distribution actions around the clock in all 50 states and 27 countries at over 500 sites located close to, and partnered with, customers and suppliers.

BSM will consist of Commercial-Off-The-Shelf (COTS) software running on existing hardware to support DLA processes. Since COTS products will only meet a portion of the BSM requirements, the use of bolt-on products and business process re-engineering are anticipated. BSM, when completely fielded, will support approximately 7,500 DLA employees located primarily at three locations: Columbus, OH; Philadelphia, PA; and Richmond, VA.

BSM supports ***Joint Vision 2020*** through significant improvements in ***focused logistics***. The modernized business environment supports power projection through flexible logistics support. Small, agile fighting units will be provided with rapid, precise, and reliable delivery of supplies to an area of operation.

BACKGROUND INFORMATION

The BSM program was conceived in late 1998 to address the radical changes in the way DLA does business and the severe deficiencies in existing information support systems. As DLA strives to align business practices with the best commercial practices by re-engineering logistics processes at all echelons, a robust technology platform is needed to support this target environment. Specifically, the BSM program is designed to establish a framework for continuous business practice improvements by:

- Shifting to commercial business practices and capitalizing on industry-based integrated supply chain solutions.

- Moving from organic to commercial sector support when business and readiness factors dictate.

- Exploiting DLA's leveraged buying capabilities and harnessing that power through value-added electronic shopping opportunities to enable customers to get the best prices and fastest delivery of products and services.

The primary objective of this initiative is the attainment of a modern business systems environment. The Joint Requirements Oversight Council-approved Mission Needs Statement identified the needs for DLA to manage to specific outcomes, allow optimization within given levels of resource, and support a management focus on product and operating-cost reduction. These objectives represent DLA's approach to meeting the requirements of the DoD and DLA Strategic Plans. The BSM strategy's first focus is to replace DLA's primary materiel management systems—the Standard Automated Materiel Management System and the Defense Integrated Subsistence Management System—with an expanded enterprise computing environment and COTS software packages that include Enterprise Resource Planning and Advanced Planning Systems. The BSM strategy, over the course of several years, will result in a new agency-wide computing architecture, which will enable DLA to reengineer its logistics processes to reflect best modern commercial business practices.

TEST & EVALUATION ACTIVITY

The BSM contract was awarded in August 2000. No DT or OT has been conducted yet. DOT&E reviewed and approved a preliminary TEMP in August 2000.

TEST & EVALUATION ASSESSMENT

No assessment results are available yet. The Program Management Office (PMO) has demonstrated proper emphasis on T&E activities needed to support the BSM program. DOT&E will continue working with JITC (the designated OTA) and the PMO to refine BSM T&E planning as the program evolves.

FUELS AUTOMATED SYSTEM (FAS)

DLA ACAT IAM Program		**Prime Contractor**
Total Number of Systems:	426 Base Level systems	Coggins Systems (Base Level)
	1 Enterprise Level system	Oracle Corporation (Enterprise Level)
Total Program Cost (TY$):	$190M	
Life Cycle Cost (TY$)	$300M	
Full-rate production:	1QFY97 for Base Level	
	3QFY01 for Enterprise Level	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Fuels Automated System (FAS) is an integrated relational data base system using an open system architecture design. Ultimately, FAS will consist of two levels–Base and Enterprise–that will collectively provide an automated, integrated, and responsive system for managing DoD fuels. The Base Level system provides transaction data at the fuel distribution terminal, whereas the Enterprise Level system will handle procurement, supply, and financial functions. The Base Level System consists of 426 Commercial-Off-The-Shelf (COTS) microcomputer servers and 1,342 COTS microcomputer workstations deployed to 622 Military Services and Defense Logistics Agency locations. The Enterprise Level system will comprise ten COTS mid-tier servers and existing office automation at the Defense Energy Support Command Headquarters, its regions, and field offices.

Designated as the Corporate Information Management initiative for the functional area of energy management, FAS will support DoD fuels management with commercially available application software and take advantage of proven commercial business practices established in the petroleum industry. FAS supports the ***Joint Vision 2020*** operational concept of ***focused logistics*** by integrating the fuels support systems to enable rapid responses to mobilization and crises.

BACKGROUND INFORMATION

The FAS program was initiated to accommodate evolving requirements for the fuels mission of the Defense Logistics Agency. FAS will increase fuel accountability at the Defense Fuel Supply Points, integrate automatic tank gauging and automated leak detection capabilities, provide a mechanism for specialized customer support through tailored terminal interfaces, and promote real-time data processing.

Since the completion of the Base Level system in FY97, the FAS PM has turned its attention to the Enterprise Level system. The Enterprise Level system comprises two increments. The Oracle Federal Financials will provide Accounts Payable, General Ledger, and Accounts Receivable functions. Oracle Energy Downstream, a COTS package that Oracle acquired from British Petroleum, will handle fuels purchases. Together, the two increments will provide a complete solution for budgetary and proprietary accounting.

During an In-Process Review in August 1997, the FAS PM declared a schedule breach because of late software product deliverables from Oracle. The PM re-baselined the program and briefed the DoD Information Technology Overarching Integrated Product Team in October 1997. Throughout FY98 and FY99, implementation of the Enterprise Level system has been delayed because the vendor failed to incorporate all requirements for prompt payment and price escalation into the Government layer of the financial applications.

TEST & EVALUATION ACTIVITY

User certification on the Oracle Federal Financials took place from August 1998-March 1999. The testing found more than one hundred software deficiencies—most of them having been fixed and closed. The remaining deficiencies are in the process of being resolved. In 2QFY99, an analysis of Oracle Energy Downstream was completed. This analysis provided confidence that the COTS product would adequately meet petroleum operating needs and integrate well with the Oracle Federal Financials product. In addition, the analysis identified opportunities for improving business processes.

For the fully integrated FAS, a combined DT/OT is scheduled for 2QFY01 during Business Acceptance Testing and Simulation of Go Live.

TEST & EVALUATION ASSESSMENT

The Joint Interoperability Test Command (JITC) conducted IOT&E for the Base Level system in FY96 and FY97, in accordance with a TEMP approved by DOT&E in August 1996. During the early part of testing, the system configuration, training, and support concepts proved to be immature. By the end of four months of testing, the Program Management Office had incorporated many system improvements into the site configurations. Evaluations by JITC and DOT&E showed that the Base Level was operationally effective and operationally suitable. In 1QFY97, the Program Manager received approval to begin fielding the Base Level system to Defense Logistics Agency and Services locations.

The combined DT/OT for the integrated FAS system is scheduled for 2QFY01, to be followed by a dedicated OT. Due to the significant program baseline and system architectural changes for the Enterprise Level system, the TEMP is being updated to reflect current performance and schedule requirements. During OT, special emphasis will be placed on the integration and interoperability of the Enterprise Level and Base Level systems in supporting DoD fuels management missions.

STANDARD PROCUREMENT SYSTEM (SPS)

DLA ACAT IAM Program		**Prime Contractor**
Total Number of Systems:	1,077 sites (42,000 users)	American Management Systems, Inc.
Total Program Cost (TY$):	$418M	
Average Unit Cost (TY$):	$388K	
Full-rate production:	FY03	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Standard Procurement System (SPS) will improve the speed and effectiveness of contract placement and contract administration functions. It will interact more effectively with other DoD activities and with industry, and improve visibility of contract deliverables while maintaining DoD readiness with reduced resources. SPS will comprise components at multiple levels, including mainframe processing at Defense Information Systems Agency MegaCenters, minicomputers at the intermediate level, and Local Area Network-based workstations at the user level. Software will consist of selected operating systems, network operating systems, client-server software, distributed systems software, and American Management Systems' commercial-derivative software.

SPS was designated the Corporate Information Management initiative for the functional area of procurement. Each Service and Agency will provide the underlying infrastructure to host the SPS software. Although SPS accommodates electronic commerce/electronic data interchange transactions, each Service and Agency must provide SPS the access to electronic commerce/electronic data interchange gateways. SPS supports the ***Joint Vision 2020*** operational concept of ***focused logistics*** by enabling Defense agencies to work more effectively with the civilian sector in procurement activities.

BACKGROUND INFORMATION

The SPS acquisition strategy is based on procuring and enhancing American Management Systems' "Procurement Desktop–Defense" software. To be delivered in four increments, SPS Increment 1 software offers basic system functionality and was fielded to limited Defense Logistics Agency and Navy sites after completing IOT&E in 3QFY97.

SPS Increment 2 software builds upon the functionality provided in Increment 1 and was operationally tested in 4QFY97. In October 1997, the Joint Interoperability Test Command (JITC) completed Increment 2 OT&E in accordance with a TEMP approved by DOT&E in July 1997. Test results showed 35 system deficiencies associated with open priority 2 trouble reports. These deficiencies had major impact to operations. After a series of additional OT activities, during which the SPS Program Management Office (PMO) addressed the outstanding priority 2 trouble reports to the satisfaction of DOT&E, JITC completed its evaluation. JITC concluded that non-automated and semi-automated procurement offices currently using or scheduled to receive Increment 1 software would benefit by the increased functionality in Increment 2. DOT&E concurred with the JITC assessment. Increment 2 software was retrofitted at sites with Increment 1, and was installed at additional selected DLA and Navy sites.

From May-June 1998, JITC conducted OT at two Army sites and OA at two Navy sites on a portion of the Increment 3 software functionality (not yet including the external system interfaces) in accordance with an OTP approved by DOT&E in May 1998. Based on the user-validated requirements in the ORD, JITC found that Increment 3 software was operationally effective and suitable for only a small number of contracting offices that had no or minimal prior automated procurement support. Due to the significant number of system deficiencies, inaccuracies, and incomplete functionality that prevented users from accomplishing their procurement mission, JITC determined that Increment 3 software was neither operationally effective nor operationally suitable for procurement offices fully supported by legacy procurement systems.

DOT&E also concluded that SPS Increment 3 software was not operationally effective and not operationally suitable. While users at the four test sites were able to complete most of the simplified acquisition procedures using Increment 3 software, significant shortfalls existed for performing functions associated with large procurement contracts. Security deficiencies allowed unauthorized users to access and alter solicitation and contract documents. User and system administration training was inadequate. In addition, more than a hundred deficiencies of major or moderate operational impact were identified. DOT&E recommended that the PMO take immediate actions to correct these deficiencies prior to full fielding.

Since the completion of Increment 3 OT&E, testing activities have been focused on conducting OAs on Increment 3 follow-on releases to verify corrections of deficiencies and to assess enhanced capabilities. In March 1999, JITC conducted an OA on an Increment 3 follow-on release (Version 4.1) to verify corrections of known system deficiencies and identify any improvements or degradation of system capabilities relative to earlier versions. The OA was conducted at the Defense Information Technology Contracting Office, Scott AFB, IL.

The results of the OA were mixed. Of the previously identified 59 deficiencies with major operational impact, users confirmed that 19 were fixed, 3 were partially fixed, 24 were not fixed, and the remaining 13 had undetermined status. Of the previously identified 76 deficiencies with moderate operational impact, users confirmed that 18 were fixed, 6 were partially fixed, 39 were not fixed, and the remaining 13 had undetermined status. Further, results indicated that new deficiencies were found—6 with major operational impact and 13 with moderate operational impact. Deficiencies were categorized as undetermined if they could have been caused by poor training or inadequate help desk support or they could not be replicated or were not associated with functions used at the Defense Information Technology Contracting Office. Despite the mixed test results, users noted that system functionality had improved in comparison with the previous versions. Furthermore, improvements were also noted in the user manuals, user interface, and system response times.

TEST & EVALUATION ACTIVITY

Throughout FY00, JITC continued to conduct OAs for SPS Increment 3 follow-on releases to provide user feedback to improve SPS performance. JITC uses sites that had already converted over to SPS from their legacy systems: Standard Army Automated Contracting System–Federal for the Army users, Automated Procurement and Data Entry system for the Navy users, and Base Contracting Automated System for the Marine Corps and Air Force users. To date, JITC has conducted OAs at 4 Army sites, 14 Navy and Marine Corps sites, and 2 Air Force sites.

TEST & EVALUATION ASSESSMENT

The attitude of the work force is generally positive toward the changes brought about by SPS. As knowledge and experience with the SPS application increase, users believe they will be better able to use SPS to support their contracting activities. They also stated that SPS holds much potential in their operational environments as the system matures. However, the currently installed versions of SPS are unforgiving of changes that need to be made in processing contracting actions. For example, even a minor change to a purchase request requires significant effort—the purchase request must be routed back and forth between the contracting specialist and the customer before the modification can be completed. This practice is time-consuming and feeds user perceptions that SPS increases the time needed to complete common contracting tasks.

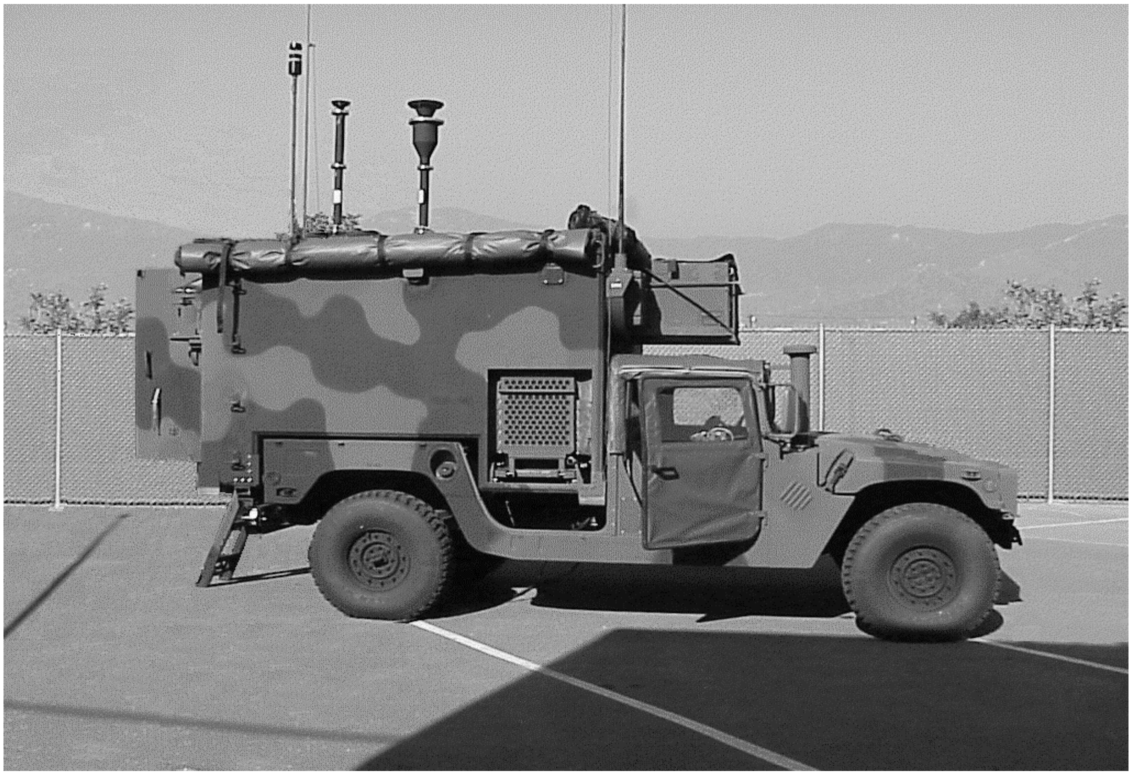
Based on Increment 3 OA findings, a variety of issues remain; some span many OA sites and some are site-unique. In general, users expressed a desire for longstanding deficiencies to be corrected. An example is the lack of system capability to support the processing of DoD 350 and 1057 reports. Accurate and reliable reports are necessary to comply with Federal Acquisition Regulation/Defense Federal Acquisition Regulation requirements. Users also expressed the need for enhancements to the system. For instance, automatic renumbering of Contract Line Item Numbers (CLINs) does not occur when a CLIN is deleted from a document, presenting a significant problem when working on large contracts with many CLINs.

DOT&E will continue to work with JITC and SPS PMO to verify deficiency corrections and functionality improvements. A full OT&E is planned for SPS Increment 4—the full operational capability system—in late FY02. Increment 4 is intended to provide full functionality to support major weapons system contracts, including all external system interfaces and electronic commerce/electronic data interchange capabilities.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

Even though progress has been made, the SPS PMO must continue to focus on correcting deficiencies identified during previous tests. To ensure that formal OT&E of Increment 4 truly tests the capability of SPS in supporting the operational missions of procurement offices, robust developmental testing and system acceptance testing must be completed first. Furthermore, the user communities and SPS PMO must be fully supportive of JITC's efforts in developing a sound and comprehensive operational test plan.

JOINT BIOLOGICAL POINT DETECTION SYSTEM (JBPDS)



Joint ACAT II Program		Prime Contractors
Total Number of Systems:	971	Hardware: Battelle
Total Program Cost (TY$):	$708M	Software: RTI
Average Unit Cost (TY$):	$342K	Logistics: Lockheed Martin
Full-rate production:	2QFY02	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The primary purpose of the Joint Biological Point Detection System (JBPDS) is to limit the effects of biological agent attacks that have the potential for catastrophic effects to U.S. forces at the operational level of war. The specific function of JBPDS is to provide biological agent point-detection, identification, and sampling capability for both fixed-site and mobile operations. The system is intended to detect biological agents in less than one minute and identifies the agents in less than 15 minutes. The Block I version, scheduled for fielding during FY01, will detect 10 agents. The follow-on Block II version, scheduled for fielding during FY06, will integrate advances in technologies to decrease size, weight, and power requirements, as well as to detect 26 agents. Both block versions will interface with the Joint Warning and Reporting Network (JWARN).

The capabilities of JBPDS will be used by each of the Services. The Army's JBPDS platform is the S788 lightweight multi-purpose shelter mounted on a High Mobility Multipurpose Wheeled Vehicle (HMMWV) - Heavy Variant. The Marine Corps will deploy a stand-alone man-portable JBPDS configuration for employment by foot-mobile reconnaissance units. The shelter-mounted unit will also be integrated as a biological component suite installed on both HMMWV-based and LAV-based Joint Services Light NBC Reconnaissance Systems (JSLNBCRS). The Marine Corps is the lead Service for development of the JSLNBCRS.

The Navy's JBPDS platform will be installed on deployable surface ships and at high priority shore installations worldwide, while the Air Force will deploy the fixed-site, man-portable, and shelter-mounted JBPDS units.

JBPDS improves the survivability of both mobile and fixed Joint forces by providing increased situational awareness and ***information superiority*** to supported headquarters and combat elements. By providing these elements with the near real-time capability of detecting biological agent contamination, JBPDS is a key portion of the ***full-dimensional protection*** concept.

BACKGROUND INFORMATION

In June 1995, the Joint Program Manager for Biological Defense approved the Milestone 0 transition of the JBPDS into the Concept Definition Phase for Block I. A Milestone I decision in June 1996 formalized and established JBPDS as an Acquisition Category (ACAT) III Program. In December 1996, the Joint Program Manger approved the Milestone II decision for JBPDS, and the system transitioned into the EMD Phase. In August 2000, the Joint Program Manager recommended that the system be re-designated an ACAT II program.

The Army is JBPDS' lead materiel developer and developmental evaluator, while the Air Force is the lead operational evaluator.

JBPDS was placed on the DOT&E Oversight List of January 18, 2000. Its potential impact on the battlefield is enormous despite the fact that it is only an ACAT II program.

TEST & EVALUATION ACTIVITY

In October and November 1999, AFOTEC conducted an Operational Utility Evaluation (OUE) of the JBPDS. The OUE was conducted during field trials sponsored by the Joint Program Manager. These trials were primarily designed to compare different trigger/detector technologies in side-by-side testing. The OUE also allowed AFOTEC to make an initial evaluation of the military effectiveness and suitability of JBPDS based upon observations and data collected during the test period.

In conjunction with MCOTEA and OPTEVFOR, AFOTEC conducted in May-June 2000 an Operational Assessment (OA) of the man-portable, fixed-site, and shipboard versions of the JBPDS. ATEC simultaneously conducted a Limited User Test (LUT) of the HMMWV-mounted version of the system. The shipboard version of the JBPDS was tested on USS *Comstock*, while the other versions were tested at Dugway Proving Ground. The Dugway testing was conducted in conjunction with JBPDS Pre-Production Qualification Testing. The Director approved the OA Plan on May 15, 2000.

AFOTEC and ATEC evaluated the military effectiveness and suitability of JBPDS in a semi-operational field setting. JBPDS units were subjected to aerosol challenges using benign biological agent simulants and typical battlefield interferents. Sophisticated instrumentation was required to determine if and when the systems were exposed to the simulated contamination.

Military and civilian operators set up, replenished, monitored, and transported these units during the field trial events. The adequacy of the training program to support JBPDS deployment was evaluated, and reliability, availability, and maintainability (RAM) data were collected throughout the test effort. Fourteen JBPDS systems were evaluated during this testing: four HMMWV-mounted, four fixed-site, five man-portable, and one shipboard.

In addition to the field testing of JBPDS with biological agent simulants, Dugway Proving Ground personnel are conducting live biological agent testing of the system inside a specially sealed biohazard-safe chamber.

Data and insights gained from the OA, LUT, and the live agent testing were used to support the Joint Program Manager for Biological Defense two-phase Low-Rate Initial Production (LRIP) decision on October 2, 2000. Under this plan, nine systems will be built for First Article Test and a second operational assessment (OA2). After OA2, if the Service Operational Test Agencies assess the system to be ready for the Initial Operational Test (IOT), up to 16 additional systems will be constructed for IOT. Specific criteria addressing detection, identification and system reliability must be met to support the second phase of LRIP and entry into IOT.

DoD Regulations state that a TEMP must be submitted to OSD within 90 days after being placed on oversight. However, based on the Program Office's progress in developing a robust test program, the Director has extended the deadline for TEMP submittal to the end of CY00.

TEST & EVALUATION ASSESSMENT

The results of the OUE, OA, LUT, and live agent testing are still emerging. Early live agent test results indicate that JBPDS shows substantial promise for detecting biological agents in a sealed chamber under closely controlled environmental conditions. However, field testing of JBPDS variants has not demonstrated that these systems can meet the requirement that they must detect biological agents at least as well as currently fielded interim systems. (The exact requirement is classified.) During field testing, the systems experienced a large number of false detections; i.e., the systems indicated the presence of biological agent simulant when no simulant was present. Background soil concentrations of simulant at the test site may have contributed to the observed high false detection rate.

Given that a detection has occurred, JBPDS must have a probability of 98 percent or better of correctly identifying the detected agent within 15 minutes. Preliminary indications are that the JBPDS did not meet this requirement for all simulants under field conditions.

The system fell well short of the requirement for Mean Time Between Operational Mission Failures of 144 hours. Numerous hardware and software deficiencies were encountered.

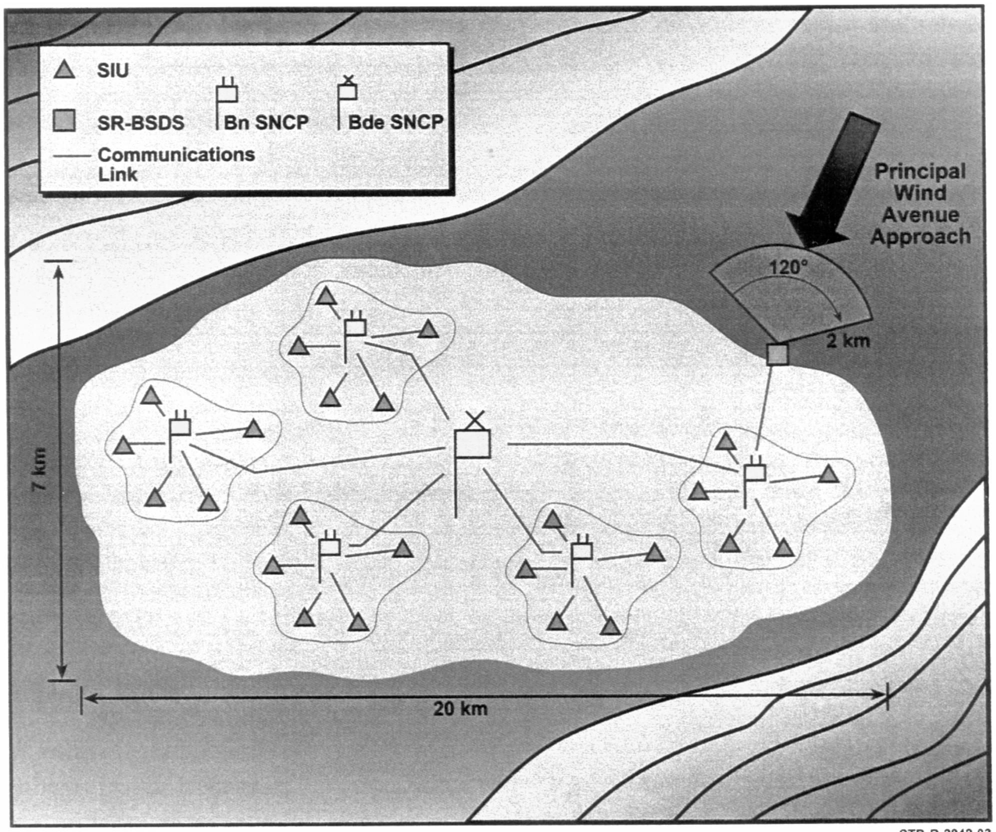
The systems demonstrated significant human factors deficiencies. Operators in protective gear experienced difficulties, particularly in assembling and disassembling the system. The systems have numerous sharp edges that can injure users and puncture protective gear. The man-portable units are so heavy that the four-man crews experienced difficulties in transporting them. The interior component configuration of the HMMWV-mounted units needs additional optimization. Generator exhaust hose leaks can allow generator exhaust to seep into the closed JBPDS shelter. The set-up time for the man-portable units often exceeded requirements.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

The JBPDS Program Management office has studied the results of the OA and the LUT, and has prepared and is implementing an aggressive program that is working toward correcting the deficiencies observed during this testing. Modifications of the system variants include an enhanced capability for detecting and identifying biological agents under field conditions, reduction of false detections, improved system reliability and software performance, and correction of demonstrated human factors deficiencies. The lack of hardware maturity evidenced during the OUE/OA/LUT puts the Program Manager's ambitious schedule in jeopardy. However, this risk is at least partially mitigated through the two-phase LRIP approach and the provision for a second Operational Assessment prior to the Initial Operational Test.

Overall responsibility for assessing the operational effectiveness, operational suitability, and survivability of each Chemical and Biological Defense program is vested in a single Service. However, it is clear that each Service Operational Test Agency will have to provide its own assessment of each program variant that will be used by its own Service.

JOINT BIOLOGICAL REMOTE EARLY WARNING SYSTEM (JBREWS) ACTD



Joint Program Office-Biological Defense ACTD

Total Number of Systems:	1 (serves 5 battalions)
Sample Identification Units:	32
Electrical Generators:	32
Short Range Biological Standoff Detection System:	1
Sensor Network Command Posts:	18
Master Radio Suites with Antenna Masts:	9
Network Communications Repeaters:	53
Total Program Cost (TY$):	$56.8M
Average Unit Cost (TY$):	N/A
Termination of ACTD:	2QFY03
USEUCOM Military Utility Assessment:	1QFY01

Prime Contractor

Johns Hopkins Applied Physics Laboratory (sys engineering / conops support)

Other contractors are ACS Defense, Midwest Research Institute, Majesko/Bio Med Tech, Sentel Corp, Freewave, Fibertek, Inc., and Camber Corp. Also participating are U.S. Army Soldier Biological and Chemical Command; Naval Surface Warfare Center, Dahlgren; Los Alamos National Laboratory; and Lawrence Livermore National Laboratory.

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The system network is comprised of an integrated suite of sensors consisting of a Short Range, Biological Standoff Detection System (SR-BSDS) and a Deployable Unit Biological Detection System (DUBDS) made up of Sample Identification Units (SIUs), the Sensor Network Command Post (SNCP), and the associated communications architecture. The ACTD system employs digital communications, compatible with JWARN. It is designed to support a self-discovering, self-healing network.

The JBREWS ACTD is intended to demonstrate an operationally capable biological remote early warning system for use by deployed ground forces in a static environment. This system should provide both automated warning of a biological attack and automated reporting of the threat to appropriate command and control nodes. It is the intent of this ACTD to demonstrate mature technologies that significantly improve the ability of a deployed force to detect a biological attack before exposure and/or identify a biological warfare attack to afford the commander the knowledge to engage medical treatment options. This unique capability mitigates the effects of biological weapons on the Joint Force.

The JBREWS ACTD system is designed to be capable of early detection, warning and automated reporting, and presumptive identification of up to eight Biological Warfare (BW) agents. The ACTD system will provide brigade/JTF area commanders (5 BN equivalent/120 km^2) with the capability to accelerate the decision cycle to warn and protect U.S. Forces and provide a real-time situational awareness of the BW defense network.

The JBREWS ACTD products will enhance the overall biological force protection system In-Theater by providing expeditionary BW sensors organic to the JTF/unit capable of autonomous operation in forward areas of a fixed installation with a much greater sensor-density than currently fielded or developmental biological detection systems. The JBREWS ACTD products will exploit the capabilities of networked sensors at a tactical level to enhance the warning and reporting of BW attacks.

The JBREWS ACTD contributes to ***Joint Vision 2020*** by enhancing the survivability of Joint Forces in that it provides increased situational awareness and ***information superiority*** to supported headquarters and forces. By providing these elements with the real-time capability of detecting biological agent cloud arrival, JBREWS contributes to ***full-dimensional protection*** to the force.

BACKGROUND INFORMATION

The United States European Command (USEUCOM) is the operational sponsor for the JBREWS ACTD. Stand-off detection of biological warfare agents is among the top five CW/BW priorities of all CINCs. Currently, stand-off detection remains unresolved before FY09. BW detection/identification organic to maneuver forces is not yet resolved.

There is a need to provide a biological remote early warning capability, organic to combat forces, across the battlespace that will result in reliable, accurate and timely detection of BW agents.

The Joint Requirements Oversight Council (JROC) Mission Need Statement for Department of Defense (DoD) Biological Defense of August 31, 1992 states that operating forces have an immediate need for the detection and identification of biological threat agents. This detection and identification is needed to provide early warning capabilities at mobile and fixed operating locations, and for mobile dismounted forces and naval and air platforms during day and night operations.

The JBREWS ACTD was initiated based on the 1995 Commander-In-Chief/Joint Requirements Oversight Council (CINC/JROC) Counterproliferation (CP) Priorities list, which stated that the detection and characterization of Biological and Chemical Warfare (BW/CW) agents were the highest priority. CINC requirements are for a capability that provides early warning of on-target/off-target biological warfare attacks for protection of U.S. Forces. This capability needs to:

- Provide early warning of biological hazards.
- Identify agent by type.
- Transmit information into a force wide warning and reporting system (JWARN).
- Detect biological warfare agents out to 2 km (good visibility at night).

The current JBREWS operational requirement document was withdrawn by the JSIG in September 1998. Operational requirements are now being addressed in two draft ORDs, the Joint Biological Tactical Detection System and the Joint Biological Stand-off Detection System; neither is yet approved.

JBREWS was placed on Oversight in January 2000.

TEST & EVALUATION ACTIVITY

The JPO-BD conducted a developmental field test of the JBREWS ACTD at Dugway Proving Ground in May 2000. To take advantage of other activities, this field test was done at the same time as (but not in competition with) the JBPDS Limited User Test and Operational Assessment; in addition, six Portal Shield Mark III samplers were deployed during the same time. The final JBREWS demonstration was conducted during September 6-18, 2000 at Dugway Proving Ground. JBREWS systems or components demonstrating sufficient maturity and operational capability will be candidates for residuals to be delivered to USEUCOM during 2QFY01. USEUCOM's military utility assessment should be completed by mid-January 2001, and will be based on the September 2000 demonstration. Should USEUCOM, and possibly other commands, decide to seek production or further development of JBREWS, DOT&E will provide appropriate oversight.

TEST & EVALUATION ASSESSMENT

The JBREWS ACTD has a draft TEMP to guide the testing for the ACTD. Although there is no present plan to place JBREWS into production, some of the JBREWS technology may be incorporated into other biological defense systems that are on DOT&E oversight; the Joint Biological Point Detection System is one possibility. If that happens, formal test and evaluation should address the operational effectiveness and operational utility of those systems, as well as the adequacy of the test venues.

JBREWS demonstration data from September 2000 will be provided to DOT&E when it is completely assembled. During the demonstration in September 2000, military personnel from USEUCOM's V Corps, 1st Infantry Division operated the JBREWS ACTD. This same unit will receive the JBREWS ACTD residual equipment should it be sent to Europe for employment.

During the September demonstration, the SR-BSDS portion of this ACTD did not perform as expected. Since this is one of the ACTD's key components, the technical manager (JPO-BD) is assessing the maturity of this technology and its appropriate use by USEUCOM. The operational manager, USEUCOM, will assess the SR-BSDS in the military utility assessment.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

In the event USEUCOM or another Command seek production or further development of this system, a TEMP with a full operational test and evaluation program will be required. Biological defense technologies developed by this ACTD that become parts of other systems need to receive full operational evaluation prior to equipping operational units.

ACTDs can bypass the disciplined evaluation of effectiveness and suitability that DoD regulations direct of all programs and DOT&E requires of Oversight programs. There is always the risk that, while the developers look at the ACTD military utility assessment as an evaluative activity, the user command may look upon the system as a “go to war” capability when in fact its effectiveness and suitability have not been established.

JOINT CHEMICAL AGENT DETECTOR (JCAD)

Joint ACAT III Program		**Prime Contractor**
Total Number of Systems:	257,135	BAE SYSTEMS
Total Program Cost (TY$):	$563M	
Average Unit Cost (TY$):	$2,010	
Full-rate production:	2QFY02	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Joint Chemical Agent Detector (JCAD) is a pocket-sized device that will automatically detect, identify, quantify, and warn users of the presence of nerve, blister, and blood chemical agents, as well as several common toxic industrial chemicals. JCAD will be mounted on a vehicle, tripod, aircraft or ship, or fastened to the operator's load bearing equipment. The system will be capable of being operated as a stand-alone detector or, by interface with the Joint Warning and Reporting Network (JWARN), as part of a network of detectors.

JCAD's hardware consists of the main Detector Unit (DU); a pre-concentrator accessory for extending the lower detection limit of the DU; and an interface cradle that includes a mount and connections to interface the DU with external power, external alarms, and other DUs to form a network. One detector configuration is planned for use by all of the Services. JCAD will replace or augment existing Service-unique chemical agent detectors.

JCAD enhances the survivability of both mobile and fixed Joint forces by providing increased situational awareness and ***information superiority*** to supported headquarters and combat elements. By providing these elements with the real-time capability of detecting chemical agent contamination, JCAD helps provide ***full-dimensional protection*** to the force.

BACKGROUND INFORMATION

A combined Milestone I/II decision was made in December 1997 that allowed JCAD to enter into Engineering and Manufacturing Development. Phase I of the EMD contract was awarded in February 1998, and the Phase II contact option was exercised in April 1999.

The Air Force is JCAD's lead materiel developer, while the Army is the lead developmental and operational evaluator.

JCAD was placed on the DOT&E Oversight List of January 18, 2000. Its potential impact is enormous despite the fact that it is only an ACAT III program.

TEST & EVALUATION ACTIVITY

The Program Director of the U.S. Air Force Human Systems Program Office approved the Milestone I/II TEMP on September 10, 1997. The program has breached its cost and schedule baseline, and due to performance problems the program is being re-baselined. The Program Manager will submit a revised TEMP after program re-baselining has been completed.

During the period from January-March 2000, the Government conducted Engineering Design Testing (EDT) of a brass board hardware and software prototype JCAD. The purpose of this testing was to provide an early assessment of the critical detection, identification, and quantification sub-systems prior to critical design review. This testing, which primarily involved challenging the device with actual chemical agents, chemical agent simulants, and common battlefield interferents, was specifically designed to reduce the Government's risk prior to finalizing the design of the device.

TEST & EVALUATION ASSESSMENT

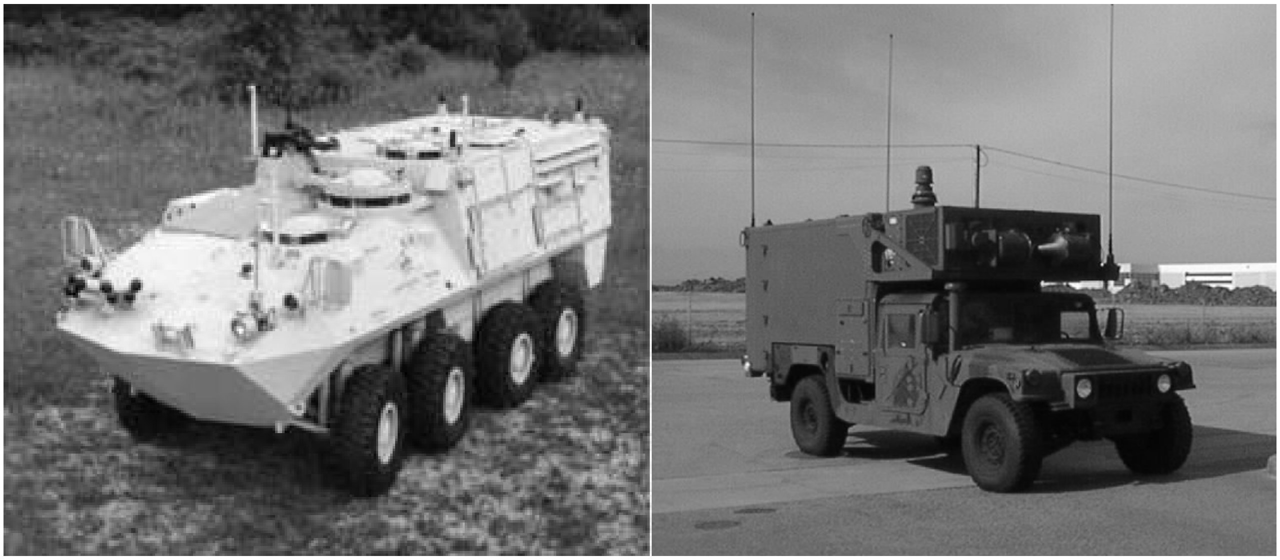
Although limited in scope, the results of the EDT indicate that JCAD is not ready to proceed beyond the critical design review. The baseline technology demonstrated the capability to detect seven out of ten chemical agents. However, the sensor algorithm requires significant improvement to reliably detect chemical agents at the concentration levels specified in the JCAD Joint Operational Requirements Document (JORD). Test results from final form factor prototypes prior to the critical design review will enable the government to reassess the performance of the algorithm.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

The JCAD Program Management office and the prime contractor are aggressively seeking ways to increase JCAD's sensitivity and detection reproducibility. In addition, the Program Manager is currently working with Air Force and Joint acquisition officials to re-baseline the program.

A possible re-baselining scenario is a significant delay in the program combined with a "block" approach to development and fielding. Under this option, a Block I device that could detect and identify some of the chemical agents specified in the JORD would be developed and fielded. A follow-on Block II device would use lessons learned from the Block I device, as well as improvements in technology, to increase the number of agents the device could detect, as well as enhance the sensitivity and reproducibility of the Block I device. The current Milestone II and draft Milestone III JORD do not reflect this acquisition approach.

JOINT SERVICES LIGHT NUCLEAR, BIOLOGICAL, AND CHEMICAL RECONNAISSANCE SYSTEM (JSLNBCRS)



Joint Program/USMC Lead		**Prime Contractor**
Total Number of Systems:	671 (HMMWV) 31 (LAV)	TRW: Tactical Systems Division
Total Program Cost (TY$):	$755.4	
Average Unit Cost (TY$):	$0.94M (HMMWV) $1.86M (LAV)	
Full-rate production:	3QFY03 (HMMWV) 4QFY04 (LAV)	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Joint Services Light Nuclear, Biological, and Chemical Reconnaissance System (JSLNBCRS) is a specialized, mobile reconnaissance system intended to detect and report NBC hazards on the battlefield. JSLNBCRS consists of a Base Vehicle equipped with hand-held and vehicle-mounted NBC detection and identification equipment. Detectors selected for use on the JSLNBCRS provide the capability to sample, detect, and identify known NBC agents as well as Toxic Industrial Materials (TIMs). Communications equipment is required to transmit analog and digital messages and NBC contamination warnings. A system for marking contaminated areas is also included. Local meteorological and accurate navigation information is provided by onboard meteorological and global positioning systems. Two base vehicles are planned: the HMMWV for the Army, Air Force, and Marine Corps, and the LAV for the Marine Corps. A central component of the JSLNBCRS is the NBC suite comprising the following:

- Joint Biological Point Detection System (JBPDS), Chemical Biological Mass Spec (CBMS) Block I, and a Surface Contamination Sampler (SCS) for detection and identification of chemical and biological agents.

- Joint Service Light Stand-off Chemical Agent Detector (JSLSCAD), for stand-off chemical detection and identification.

- Chemical agent monitor (Improved Chemical Agent Monitor (ICAM)/Chemical Agent Detector II (CAM II) for hand-held, dismounted monitoring of nerve and mustard chemical agents.

- Automatic Chemical Agent Detector Alarm (ACADA) for detecting nerve and blister agent vapors and alerting the crew.

- ADM-300 radiation detector for detecting radiation from neutrons and gamma rays, displaying levels, and storing doses.

- AN/PSN-11 PLGR for navigational information.

- SINCGARS for secure voice and data communications.

- METSMAN for meteorological sensing.

- Central Data Processing Unit (CDPU) to collect, organize, and store data.

- Sampling system for collecting samples of soil, liquid, small animals, and vegetation.

- Marking system for delineation of areas of contamination.

JSLNBCRS will be employed in forward combat areas and integrated into the overall reconnaissance and surveillance effort to support combat operations. It will also be employed in rear areas to monitor main supply routes, logistics bases, airfields, ports, and key command and control centers for NBC hazards. JSLNBCRS supports the ***Joint Vision 2020*** goals of ***full-dimensional protection*** and ***situational awareness*** by providing new sensors and information dissemination systems to detect chemical or biological attack at extended ranges and provide warning to affected units.

BACKGROUND INFORMATION

The Tactical Systems Division of TRW was awarded a four-phase contract in September 1998 that includes Concept Exploration (CE), Program Definition Risk Reduction (PDRR), Engineering Manufacturing and Development (EMD), and Post-EMD to build and integrate the HMMWV base vehicle and support Developmental Testing. Additionally, two LAV base vehicles have been refurbished using the Inspect and Repair Only as Needed program and will begin their own build and integration phase during EMD.

An Analysis of Alternatives/Tailored Executive Analysis, which was conducted during PDRR, included trade studies of vehicle platform, NBC sensors, collective protection, surface samplers, and computers. The Assistant Commandant of the Marine Corps approved the Joint Operational Requirements Document (JORD) for the JSLNBCRS on October 14, 1997.

JSLNBCRS was placed on DOT&E oversight on January 18, 2000, during the Program Definition and Risk Reduction (PDRR) phase of its development. Following designation as a DOT&E

oversight program, the USMC, as the lead Service, has undertaken an extensive review and revision of the JSLNBCRS TEMP. A Milestone II is planned for early 2001.

TEST & EVALUATION ACTIVITY

Three HMMWV systems are being fabricated for Developmental Testing (DT I) during PDRR. These systems will be equipped with command and control hardware/software and an NBC suite, using developmental versions of the Joint Services Light Standoff Chemical Agent Detector (JSLSCAD, also on Oversight), Chemical and Biological Mass Spectrometer (CBMS), and Joint Biological Point Detection System (JBPDS). In addition to the JSLSCAD, one vehicle will be equipped to mount two alternative stand-off chemical agent detectors – the Mobile Chemical Agent Detector (MCAD) and the Remote Air Pollution Identification Detector (RAPID) – bringing to three the number of candidate chemical stand-off detectors that will be tested. Command and control and sensor/sampling functionality will be tested. DT I will also test collective protection, mobility, climate control, and human factors engineering. An Engineering Design Test is planned for the LAV during January-March FY02.

A second phase of Developmental Testing (DT II) for the HMMWV variant will be conducted during April-August 2001. These vehicles will be the subjects of a Limited User Test (LUT) during July and August 2001. Key to this phase is the technical integration and update of production-representative CB sensors, notably the JSLSCAD, CBMS, and JBPDS. The LUT will support an LRIP decision in October 2001.

Production-representative HMMWVs and LAVs will be operationally tested from December 2002-March 2003. The vehicles will be tested in Service-representative scenarios, including NBC reconnaissance in support of offensive and defensive tactical operations and rear area operations. Simulated field-dispersed CB agents, and an instrumented radiological simulator will be used to challenge the NBC suite and stimulate message traffic and reporting to higher headquarters over the C^2 network. Each scenario will have appropriate adjacent and higher headquarters networks and nodes.

TEST & EVALUATION ASSESSMENT

The biggest ***effectiveness*** issue facing JSLNBCRS will be the integration, performance, and stability of the NBC suite for IOT. JSLNBCRS, which is dependent on several key programs, including JSLSCAD, JBPDS, and CBMS, will be challenged by the timing and performance of these externally managed systems. The PM must address risk mitigation and Block development should one or more of these systems fail or not be ready in time for IOT.

The JSLNBCRS Acquisition Strategy and TEMP have addressed this risk in several ways. First, the EMD phase is preceded by a robust technical development phase (DT I) where multiple sensors and basic functionality will be tested. Second, a LUT, which is scheduled after DT II, will support the LRIP decision. The PM has established clearly defined configuration thresholds and objectives for the LUT and IOT. Third, the PM has allowed for a DT III following the LUT to address design changes and schedule slips prior to IOT.

The PM must demonstrate that the LAV, with integrated NBC suite, is production-representative before beginning operational testing.

The PM has not included JWARN in the core program to be tested and fielded, since a production-representative version of JWARN is some two years behind the JSLNBCRS schedule. The program is developing a less capable Computer and Data Processing Unit to perform basic integration and reporting functions. JWARN must be integrated and tested after core JSLNBCRS fielding, and subject to Follow-on OT&E.

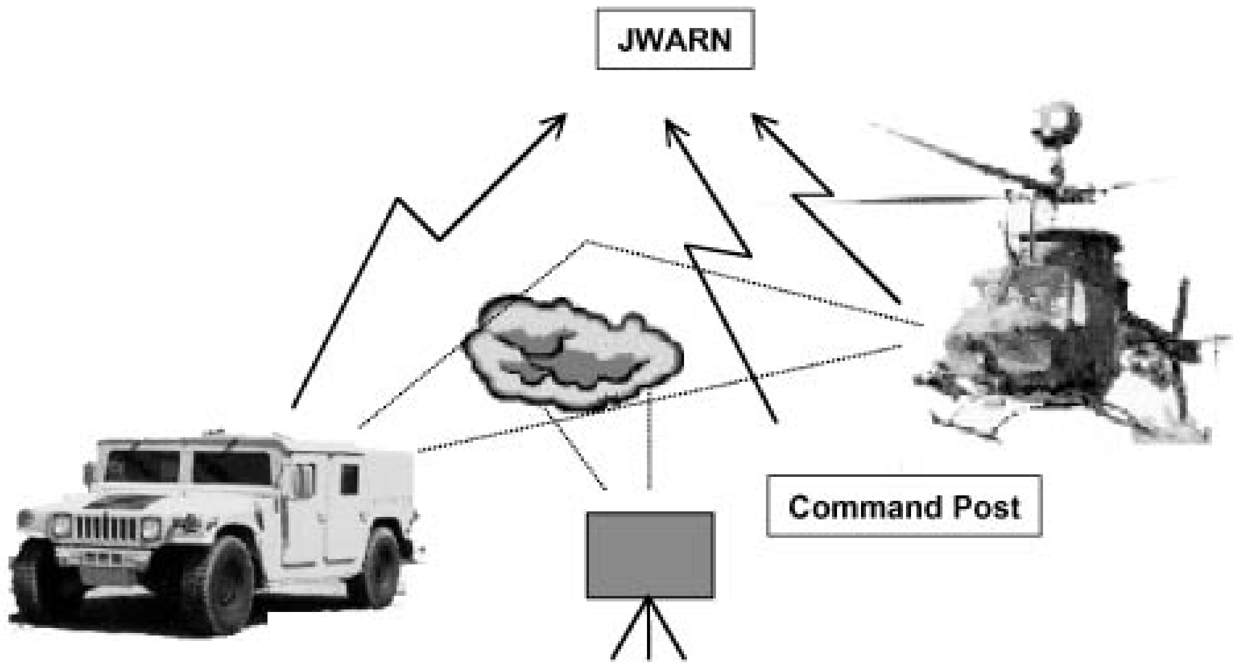
The Capstone System Threat Assessment (STAR), Chemical and Biological Systems, dated June 2, 1997, has expired, but the Marine Corps Intelligence Activity (MCIA) has developed a draft specific System Threat Assessment for JSLNBCRS.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

Although JSLNBCRS is dependent on the schedule and performance of externally managed NBC sensor programs, the PM has adequately addressed this risk in the Acquisition Strategy and test plans for the program.

Designation of this program as a DOT&E oversight program has stimulated a review of C^4ISR interoperability issues and testing plans by the Joint Interoperability Test Command.

JOINT SERVICES LIGHTWEIGHT STANDOFF CHEMICAL AGENT DETECTOR (JSLSCAD)



Joint ACAT III Program		**Prime Contractor**
Total Number of Systems:	1,917	Intellitec
Army:	492	
Air Force:	567	
Navy:	627	
Marines:	231	
Total Program Cost (TY$):	$365M	
Average Unit Cost (TY$):	$105K	
Full-rate production:	4QFY02	
PQT/IOT&E Fabrication	4QFY00-2QFY01	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Joint Services Lightweight Standoff Chemical Action Detector (JSLSCAD) is a passive, stand-off device intended to provide stand-off detection of chemical agent vapors up to 5 km (with a 10km objective). JSLSCAD is required to provide real-time on the move, chemical agent detection for contamination avoidance and reconnaissance systems. JSLSCAD consists of four major components: Scanner Module (SM), Sensor Electronics Module (SEM), Operator Display Unit (ODU), and Power adapter (PA). There are two configurations of the scanner module. The aerial applications scanner covers a 60 degree forward looking cone, while the ground mobile/fixed site/shipboard configurations scans 360 degrees in azimuth and +50 to –10 degrees in elevation. The system, which will be used as part of the Joint Service Light NBC Reconnaissance System (JSLNBCRS), will be employed aboard

Navy Landing Ship Docks (LSDs) or equivalent aviation capable amphibious ships. JSLSCAD will also be carried on Army and Navy helicopters, and outboard on Air Force MC-130E aircraft. Present plans call for the JSLSCAD to be carried as an Unmanned Aerial Vehicle (UAV) payload, but the UAV to be used has not been selected. This system will be installed in fixed locations for protection of facilities and installations such as air bases. JSLSCAD will provide visual and audible indicators, and will display the chemical agent class (nerve, blister, and blood) and indicate the location (azimuth and elevation) of the detection. Detection and warning information may be entered automatically into Service C^4 systems, or the information may be reviewed and distributed manually. JSLSCAD is to be interoperable with the Joint Warning and Reporting System (JWARN), and thus will provide chemical agent vapor detection warning for a Joint Task Force commander or a theater command and control function.

BACKGROUND INFORMATION

JSLSCAD is intended to meet the CW threat to U.S. Forces as documented in the Capstone System Threat Report, "Chemical and Biological Warfare Defense Systems-Non Medical," dated November 1996. Current systems cannot be operated on the move, nor do they provide 360-degree coverage. The current operational requirements document was approved in June 1997, but is now being revised. JSLSCAD achieved Milestone II on September 17, 1996. The TEMP for JSLSCAD was approved in 1997 by the program manager, before the system came under DOT&E oversight in January 2000. A revised TEMP was prepared in mid-2000 that includes Part IV, OT&E, with annexes addressing the Navy's shipboard OT&E, NAVAIR's OT&E on the CH-53E Super Sea Stallion helicopter, and the Air Force's possible OT&E on MC-130E aircraft.

TEST & EVALUATION ACTIVITY

JSLSCAD is currently undergoing engineering development tests, scheduled to be completed January 31, 2001. Production qualification testing will begin in April 2001, and will include arctic, tropic, and desert performance and storage as well as safety of flight certifications and agent chamber tests at Dugway Proving Ground. Field testing of this system includes the use of four simulants: sulfur hexafluoride (SF_6), acetic acid, tri-ethyl phosphate (TEP), and paraxylene. Paraxylene will be used in DT only, not OT. The Navy plans to test JSLSCAD with simulant releases at sea and on the Potomac River near Dahlgren, VA, during DT. There may be simulant releases at sea during IOT&E, but this has not yet been decided. IOT&E is planned to begin in September 2001, and continue through October 2001. There is to be a system evaluation report by April 30, 2002, with a Milestone III decision expected by the end of June 2002.

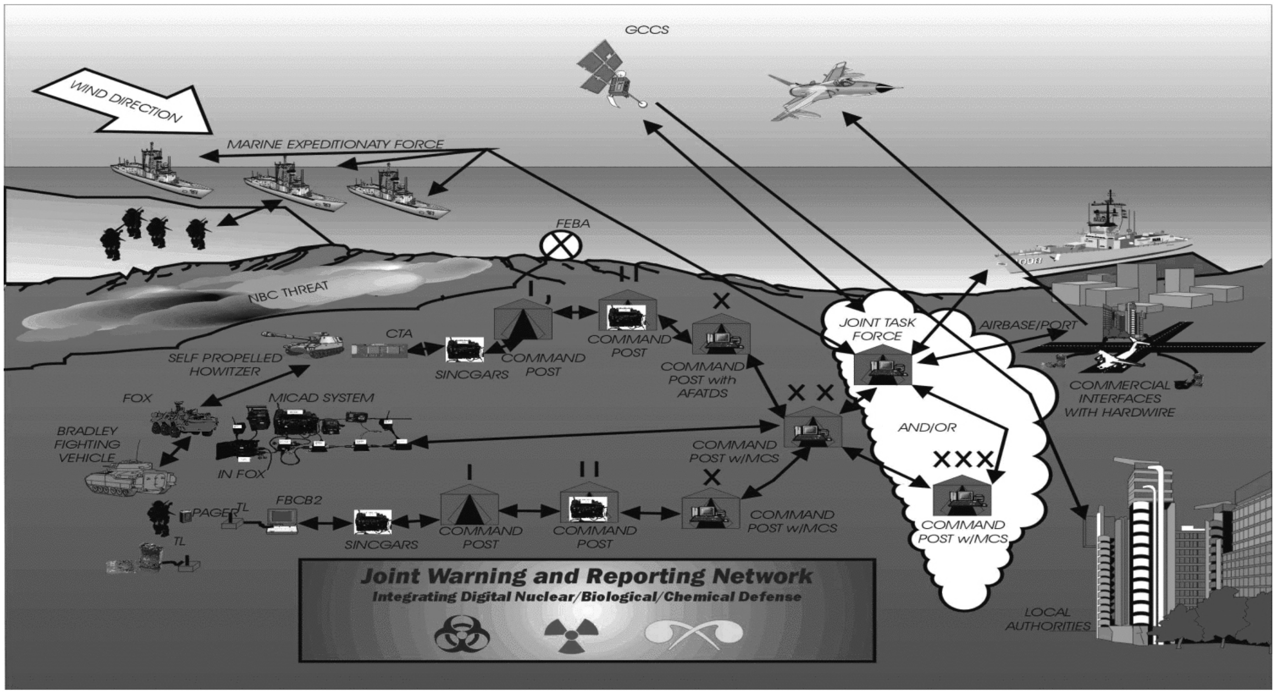
TEST & EVALUATION ASSESSMENT

Operational testing is planned to be conducted under conditions representative of the expected employment environments with a representative friendly force and C4 network, but will be limited in that no live agent will be used [except in controlled chamber testing]. Airborne, fixed site, and ground mobile testing will be at Dugway Proving Ground; shipboard testing will be done aboard a U.S. Navy FFG. Two problems may affect PQT/IOT&E. The test budget for FY01 is not fully funded ($5,417,000 is funded, with $2,750,000 unfunded). In addition, the Utah Department of Environmental Quality has approved only three of the four simulant chemicals intended for open-air DT at Dugway; approval remains in doubt for paraxylene. All three simulants to be used for OT (SF_6, acetic acid, and TEP) have been approved. Cost and environmental factors prevented the use of an air base or other military installation in OT.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

The test and evaluation program for JSLSCAD appears to be sound, but the artificialities imposed by the danger of open-air testing with active agent will leave some doubt as to the operational effectiveness and operational utility of this system. Testing limitations include the use of simulants in OT&E instead of live agent. These simulants approximate the chemical characteristics of real agent, but do not entirely match actual agents. Other limitations include simulation of delivery of agent by use of explosive and line and stack release devices instead of actual weapons, and the use of a restricted C^4 network warning capability instead of a full theater or Joint Task Force C^4 system. Also, achieving ideal delivery conditions during testing is difficult because of the vagaries of weather, and the desired effects of the atmospheric mixing layer dictates that releases are best made during the night and early morning hours. The test site, Dugway Proving Ground, is itself a limitation in that it is an isolated, desert location that does not replicate military installations, urban areas, or many types of battlefields where JSLSCAD likely will be deployed.

JOINT WARNING AND REPORTING NETWORK (JWARN)



USMC ACAT III Program

Total Number of Systems:	
HID	49,349
Software	2,380
Total Program Cost (TY$):	$135.44M
Average Unit Cost (HID) (TY$):	$1,700
Full-rate production:	1QFY04

Prime Contractor

Source selection completed. Contractor will be announced after MS II

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Joint Warning And Reporting Network (JWARN) is a standardized software application that is intended to provide NBC warning and reporting, downwind hazard prediction, operations planning, and NBC management capabilities for Joint Forces, from battalion to theater-level command. JWARN will be located in the NBC Cell of Command and Control Centers and employed by NBC specialists and other designated personnel. In peacetime, JWARN will assist local commanders to assess and predict the effects of Toxic Industrial Materials (TIM) accidents. Its primary functions are summarized below:

Essential Wartime tasks

- Report and warn Commanders and personnel of NBC attacks.
- Perform analysis of NBC information, and conduct hazard prediction, modeling, and simulation of NBC attacks.
- Support planning and assessments of NBC defense.

Peacetime tasks

- Support assessments and predict effects of TIM accidents.

Supporting tasks

- Support sensor management including maintenance planning, configuration control, performance monitoring, and testing.
- Perform Network Security.

JWARN will be hosted by Joint and Service-unique C^4ISR systems, and will share with other data bases – linked in common to the host – information on friendly and enemy forces, terrain, and weather. JWARN will also be required to use the host's messaging and overlay generators to perform its essential tasks. As a C^4ISR-interoperable application, JWARN is required to be compliant with the Joint Technical Architecture (JTA) and its Defense Information Infrastructure Common Operating Environment (DII COE) to facilitate the exchange of compatible information. JTA and its mandated DII COE is a broad set of common DoD guidelines, standards, and specifications for C^4ISR software applications and operating systems. Compliance with these standards is the first step toward achieving interoperability of software applications. JWARN is intended to interoperate with the following C^4ISR systems: Global Command and Control System (GCCS), GCCS-Army (GCCS-A), GCCS-Maritime (GCCS-M), Maneuver Combat System (MCS), the Theater Battle Management Core Systems (TBMCS), Force XXI Battle Command, Brigade and Below (FBCB2), Advanced Field Artillery Tactical Data System (AFATDS), and Command and Control PC (C2PC).

This system is intended to exchange information with legacy and new development NBC sensors, including the M8A1 Chemical Agent Alarm, M21 Remote Sensing Chemical Agent Automatic Alarm (RSCAAL), M22 Automated Chemical Agent Detection Alarm (ACADA), Integrated Point Detection System (IPDS), RADIAC AN/VDR-2, RADIAC ADM-300A, and the following Oversight systems: Joint Biological Point Detection System (JBPDS), Joint Services Lightweight Standoff Chemical Agent Detector (JSLSCAD), Joint Chemical Agent Detector (JCAD), NBCRS Fox, and Joint Services Light NBC Reconnaissance Vehicle (JSLNBCRS). A Hardware Interface Device (HID) will link these NBC sensors to JWARN and Service command and control systems via radio or wire communications.

JWARN supports ***Joint Vision 2020*** goals of ***full-dimensional protection*** and ***situational awareness*** by providing new information warning and dissemination systems for commanders.

BACKGROUND INFORMATION

The Marine Corps is the lead Service for JWARN development, and the Commander, Marine Corps Systems Command, is the Milestone Decision Authority (MDA).

The program is associated with a Joint DoD Mission Need Statement for NBC Defense, dated July 16, 1999. A draft Joint Operational Requirements Document (JORD), dated July 27, 1999, is in the final stages of staffing, and will be the baseline for operational testing and the Milestone III decision. Although the Capstone System Threat Assessment (STAR), Chemical and Biological Systems, dated June 2, 1997, has expired, the program responds to numerous threat documents, including the Defense Intelligence Agency Threat Environment Projection: Chemical and Biological Warfare 2000-2025.

The current program evolved from an earlier program called Block I JWARN. In FY97 the MDA approved the fielding of Block IA, which comprised a collection of Commercial and Government Off-The-Shelf (COTS/GOTS) software: NBC analysis for DOS, Hazard Prediction Assessment Capability (HPAC), Vapor Liquid, Solid Tracking (VLSTRACK), and Emergency Information Management System (EMIS). Since this initial fielding, JWARN functions have been successfully integrated with the Army's UNIX-based Maneuver Control System (MCS) (Block IB), and with the Windows 98 and Windows NT operating environments for the USAF, USN, and USMC (Block IC). Blocks IA and IC have been fielded. Block IB was not fielded, but successfully demonstrated the compatibility of JWARN with the JTA and DII COE. Additionally, Block IB demonstrated the transfer of information between an Army legacy chemical sensor (MICAD), a hardware interface, and the tactical Internet. The Block I program eventually led to the formal designation by OSD of HPAC and VLSTRACK as standard DOD hazard prediction models.

Block IA and Block IC testing has been technical, focused on stand-alone functionality and integration with the Windows operating system. Block IB integration of basic JWARN functionality with MCS is significant, since this architecture, including the use of an open DII COE compliant operating system, shared data bases, and message servers, is typical of the C^4ISR systems targeted by JWARN. Block IB testing was a limited, and successful, technical demonstration of information compatibility and DII COE compliance. Following an evolutionary approach to development, Block I has served as a significant risk-reduction measure for the current program.

On December 18, 1997, the MDA approved a Program Definition and Risk Reduction (PDRR) phase for Block II development, the current program, and activities associated with this effort were completed in January 2000. During PDRR, a Performance Specification and the Interface Requirements Specification were completed as a prelude to a solicitation for Engineering and Manufacturing Development (EMD). The MDA has completed source selection, but the contract will not be awarded until a successful Milestone II.

After achieving a successful Milestone II decision, the development of JWARN is planned to proceed incrementally, first targeting Service C^4ISR systems that are DII COE compliant, and then expanding to include Service-unique systems. The development of JWARN functionality and integration of this functionality with the C^4ISR systems is planned to proceed incrementally as well. First, JWARN messaging capability will be integrated with GCCS, GCCS-M, MCS, and TBMCS (Core Capabilities Increment). Second, integration with overlays and overlay drivers and interfaces with joint DII COE compliant data bases (e.g., NBC data, friendly forces, weather, terrain, intelligence) will be developed for these systems and for GCCS-A, AFATDS, FBCB2, and C2PC (Full Capabilities Increment). The Hardware Interface Devices will be developed concurrently, and low-rate quantities will be delivered to the government to support IOT&E in mid-FY03.

TEST & EVALUATION ACTIVITY

Following designation as a DOT&E oversight program on January 18, 2000, the USMC, as lead Service, has undertaken an extensive review of the JWARN TEMP and Acquisition Strategy. Following a failed Milestone II review in May 2000, the MDA changed program management by forming a partnership between the C^4ISR SE&I branch and CSLE MAR/NBC branch of Marine Corps Systems Command. DOT&E has worked closely with the program since its placement on the Oversight list to improve its TEMP, and the JWARN team continues to address the many issues raised by DOT&E. These issues include: failure to adequately describe the content of the program, integrated schedule, performance measures, scope of technical and operational testing, and resources. The MDA will schedule a Milestone II review of the program when its TEMP is completed and approved by the Services and DOT&E.

A post-Milestone II Operational Assessment (OA) is planned for 1QFY03 (near the end of Full Capabilities Increment EMD phase). This OA will support an LRIP decision for the HIDs for IOT and is timed to influence software stability prior to the operational test.

A multi-Service IOT is scheduled for 3QFY03 to support a Milestone III decision in 1QFY04. Although the EMD is intended to proceed incrementally – function-by-function and system-by-system – the IOT&E will assess the full capabilities of JWARN as specified in the JORD. The Joint Interoperability Test Command (JITC) will play a key role in certifying technical compliance of JWARN prior to entering IOT, and in assessing its interoperability with the Service C^4ISR systems as a part of the operational test.

TEST & EVALUATION ASSESSMENT

No specific threat support package or threat CONOPS to support JWARN testing has been developed. The JORD does not include a top-level, user-oriented Interface Exchange Requirement (IER) as required by CJCSI 3170, Requirements Generation System that explains the basic characteristics of the information that needs to be exchanged in order to accomplish the mission.

JWARN is an extremely complex system – first, because it is inherently a software application and, second, because it must integrate with so many joint C^4ISR systems and NBC sensors. To date, Measures of Effectiveness and Performance have been exclusively technical, or focused on maintainability and environmental suitability. As a result, a significant degree of planning is necessary to bridge the gap between technical criteria and operational criteria for IOT, and to understand exactly what information is to be exchanged and by what systems. There also has been a tendency to view the performance of JWARN in isolation – first from the NBC sensors and, second, from the host C^4ISR systems. The IOT will be challenged to conduct operational testing within the context of the total system of forces, sensors, and C^4ISR systems.

Despite the significant development already demonstrated with Block I and the PDRR phase, the program has yet to develop a sound Acquisition Strategy, and the TEMP has failed to describe system content, development priorities, scope of planned testing, and resources adequately.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

The MDA's decision to form a partnership between NBC and C^4ISR program managers responds directly to the shortcomings of the program and its designation as a DOT&E Oversight program. A continuing and expanding partnership with the C^4ISR community, including program managers of targeted command and control systems, and with the program managers of new development sensors, will be required for successful planning and testing.

Before the TEMP is approved by DOT&E, it must present a coherent test program consistent with the guidelines of DoD Directive 5000.2-R.

COMPOSITE HEALTH CARE SYSTEM II (CHCS II)

ASD(HA) ACAT IAM Program		**Prime Contractor**
Total Number of Systems:	170 Sites	Multiple Contractors: SAIC, CTA, IBA,
Total Program Cost (TY$):	$1,330M	Northrop Grumman, Iona, SRA, USI,
Average Unit Cost (TY$):	$7.8M	Birch & Davis
Initial Operating Capability:	2QFY01	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

First introduced in 1989, the Composite Health Care System (CHCS) is a tri-Service, medical management Automated Information System (AIS) now used in all DoD military Medical Treatment Facilities (MTFs) worldwide to support hospital administration and clinical health care. CHCS II, which expands on and will eventually subsume the original CHCS, is the target automated information system for the clinical business area of DoD's Military Health System (MHS). It is an evolutionary program intended to integrate the functionalities of over 40 different DoD and Service-unique AISs in varying stages of development, and create Computer-based Patient Records (CPRs) for all MHS beneficiaries. Nearly all of the new applications being integrated into CHCS II are commercial-off-the-shelf products. CHCS II supports the ***Joint Vision 2020*** concept of ***information superiority*** by integrating all the clinical systems of the three Services into a single joint system, increasing access to information, taking advantage of advanced business practices, incorporating the civilian health care sector, and allowing MTFs to be more efficient in protecting lives and resources.

BACKGROUND INFORMATION

OT&E has been conducted continuously on CHCS since its inception in 1989. When CHCS II was placed under OSD oversight in 1997, the original CHCS became a legacy system and was removed from oversight. Although a few standalone applications that will be integrated into CHCS II have undergone OT&E, CHCS II has yet to be tested as an integrated system. OT&E on two initial applications were conducted under the auspices of a CHCS II TEMP approved by DOT&E in 1997.

The first application to undergo OT&E in April 1998 was the Clinical Information System (CIS). CIS supports inpatient care by allowing health care providers to electronically view records of treatment and medication summaries, enter orders and treatment notes, and monitor vital signs of patients. It offers a foundation for CPRs, which is the ultimate objective of CHCS II. The Army Test and Evaluation Command (ATEC), the independent OTA, found CIS to be operationally effective, suitable, and survivable. An independent DOT&E assessment determined that CIS offers significant improvement over paper-based procedures and successfully performs the functions it was designed to do.

The second application to undergo OT&E was the Preventive Health Care Application (PHCA), which is used to document patient history, track immunizations, and recommend appropriate preventive care. OT was conducted on PHCA in September and October 1998, at Beaufort Naval Hospital, SC, and at two MTFs in San Antonio, TX. Many of the initial test results were unsatisfactory, mostly due to improper system installation and workstation configurations. Following IOT&E, the PHCA Project Manager corrected the problems and FOT&E confirmed that everything was favorably resolved. ATEC then concluded that the system was operationally effective, suitable, and survivable. DOT&E concurred.

TEST & EVALUATION ACTIVITY

In April and May 1999, ATEC conducted an OA on a CHCS II prototype system that was installed in only three clinics in Hawaii. The test results indicated that the prototype system was neither operationally effective nor suitable, and was not accepted by the users—most of whom ceased to use it following the OA. However, the OA results provided valuable information used to design the first major release (Release 1) of CHCS II after substantial operational and technical architectural changes were incorporated.

In August 2000, ATEC conducted an abbreviated OA in Hawaii on an early version of Release 1. Most of the users agreed that Release 1 was superior to the version tested the year before, but they also complained that it was still slow and unstable. Some Hawaii users were frustrated with the system's complexity, frequent "crashes," and inability to store notes reliably.

Release 1 has now been installed at beta test sites in the Tidewater area of Virginia, and DT&E continues in an effort to correct the kinds of problems apparent during the abbreviated OA. Meanwhile, the CHCS II ORD has been revised and is approved by the Joint Requirements Oversight Council. Following the completion of DT&E, and DOT&E approval of the TEMP and test plan, OT&E is tentatively scheduled for November 2000 (more probably later) at Portsmouth Naval Hospital, VA; Langley AFB, VA; and Seymour-Johnson AFB, NC.

TEST & EVALUATION ASSESSMENT

CHCS II is very complex, and planning for IOT&E of the integrated system has been problematic. The PM has very effectively implemented the Integrated Product and Process Development initiative, but with so many migration and legacy systems (each with its own product manager), and with such large Integrated Product Teams (IPTs), the process can be cumbersome. DOT&E actively participates in these IPTs to provide responsive OT&E guidance and streamline their activities. However, the funding fluctuations and constant architectural changes have made it difficult to establish a baseline for planning.

Since it will be DoD's premier health care system, CHCS II will have a tremendous operational impact on the fighting force. The CPR will be the first (military or civilian) cradle-to-grave automated health care record—one that can revolutionize the effectiveness of the MHS by providing instantaneous patient information to health care providers worldwide. An associated "smart card" called the Personal Information Carrier will enable the warfighters to carry some of this information with them, thus enhancing combat effectiveness by expediting health care at all levels.

CHCS II faces many serious challenges. Technically, it is on the leading edge of technology and must link multiple commercial-off-the-shelf products together, both within and among nearly 170 MTFs and dental facilities worldwide, in a way that is not being done or is even feasible in the civilian sector. Operationally, it means a new way of doing business for many health care providers required to become more and more "computer literate." CHCS II also introduces some new procedures, such as the use of templates to record patient encounters in an effort to standardize the CPR. As a consequence of these and other challenges, the CHCS II development schedule has been revised several times.

DOT&E will continue to actively support the IPT process and directly assist in test planning so that IOT&E can take place as soon as practicable. Once the test results are in and DOT&E has completed its independent assessment, its recommendations should aid the PM in fielding the best possible system to support the military health system.

CORPORATE EXECUTIVE INFORMATION SYSTEM (CEIS)

ASD(HA) ACAT IAM Program		**Prime Contractors**
Total Number of Systems:	150 Sites	EDS and SAIC
Total Program Cost (TY$):	$423M	
Average Unit Cost (TY$):	$2.8M	
Full-rate Production (V1.0):	4QFY97	
Full-rate Production (V2.0):	TBD	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Corporate Executive Information System (CEIS) is a tri-Service system for integrating executive information support across the Military Health System (MHS). It will support the clinical, financial, and management needs of military medical treatment facilities (MTFs), tri-Service Health Care (TRICARE) Lead Agents, Service Intermediate Commands, the three military department Surgeons General, and the Office of the Assistant Secretary of Defense (Health Affairs) [ASD(HA)]. CEIS integrates commercial-off-the-shelf executive information and decision support systems. The executive information system offers a top-down view of the health care enterprise, integrating data from many sources, producing reports, and linking decision makers. The decision support system provides a single source of integrated, patient-level information to the health care enterprise, incorporating clinical, financial, and administrative data. There is a large active user community (over 7,000 users) within DoD, with user organizations ranging from small community hospitals to multi-facility health care enterprises.

The CEIS architecture includes two major groups of servers: (1) "data warehouses" of integrated data base servers housing repositories of health services data integrated from major MHS operational automated information systems; and (2) "data marts" of distributed servers housing patient-level care data and pre-approved information products that evaluate and assist in improving MHS. Currently, CEIS is based on a distributed client-server processing architecture built around TRICARE regional data bases fed by selected central data bases and data bases located at MTFs.

The core of the CEIS architecture is an open relational data base management system that fuses information into a single authoritative and consistent source. CEIS does not manufacture data; it extracts "evaluation" data from source data collection systems and integrates it in the data warehouse. Some of the source data collection system feeds are local to individual MTFs, while others are centralized systems serving multiple locations. CEIS supports ***Joint Vision 2020*** by providing health care managers and providers with the capability to collect, process, and disseminate an uninterrupted flow of medical information. It enhances ***information superiority*** by providing decision makers with accurate information in a timely manner, allowing them to be more effective and efficient in providing health services.

BACKGROUND INFORMATION

CEIS is being acquired for the MHS by ASD(HA), with the Army Surgeon General designated as Executive Agent. The new system was originally intended to subsume the functionalities of eight legacy systems. Seven of these systems have already been turned off, and now CEIS has become the target system for the migration of all systems within the Executive Information/Decision Support area of the MHS. It is considered critical to the effective management of DoD's TRICARE program.

A Government Installation and Acceptance Test (GIAT) was conducted in June 1997. This was a two-phase, combined DT/OT effort. Army Test and Evaluation Command (ATEC), the independent OTA, participated in the first phase of the GIAT, observing DT&E and gathering selected information for assessment. ATEC then conducted a dedicated OT in June and July 1997, with most of the data provided by the users. During this phase, ATEC collected operational data at 14 test sites and conducted user desk audits for qualitative data. ATEC also evaluated the quality of system manuals and documents.

Although CEIS has undergone several incremental enhancements since 1997, it has not changed substantially. During this period, ATEC continuously evaluated the system and performed risk assessments, which determined that full OT&E would not be required until the next major release, CEIS 2.0. Development of CEIS 2.0, however, was delayed indefinitely by problems associated with creating an Enterprise Data Warehouse (EDW) to replace the regional data bases. A single EDW could not be designed to provide reliable data, and a new system architecture had to be developed.

TEST & EVALUATION ACTIVITY

In June 2000, AEC and the U.S. Army Medical Department Board (AMEDDBD) performed an OA of the incremental release CEIS 1.10. This is an enhancement known as the All-Region Server (ARS) Bridge, which provides a trans-regional aggregate view of cost and treatment data to the top three levels of users. ATEC and AMEDDBD conducted the OA in Falls Church, VA, and concluded that the ARS Bridge was operationally effective, but not operationally suitable due to training deficiencies.

DOT&E concurred. Recommendations were provided to improve the web-based training and on-line manuals.

TEST & EVALUATION ASSESSMENT

The 1997 IOT&E was very positive for an emerging system. Combined DT/OT proved to be a very effective testing methodology for CEIS, as it can be for other automated information systems. For a system like CEIS, in which both DT and OT took place at a relatively large number of test sites (14 MTFs), much of the DT data could also be used to evaluate performance in the operational environment, particularly since it was supplemented by information obtained directly from the users. In the case of CEIS, it was possible to obtain most of the quantitative data electronically; and with combined DT/OT, the cost of testing (both dollars and people) was significantly lower than it might have been.

Despite the early success of CEIS 1.0, development of CEIS 2.0 did not go as planned because of deficient system architectural design and unsettled functional requirements. The program is now being re-baselined, and a new TEMP will be required. Nevertheless, the same combined DT/OT testing methodology that worked well with Version 1.0 and its enhancements should be effective with Version 2.0 as well.

DEFENSE MEDICAL LOGISTICS STANDARD SUPPORT AUTOMATED INFORMATION SYSTEM (DMLSS AIS)

ASD(HA) ACAT IAM Program		**Prime Contractor**
Total Number of Systems:	110 Sites	EDS
Total Program Cost (TY$):	$456M	
Average Unit Cost (TY$):	$4.1M	
Full-rate Production (R1.0):	4QFY96	
Full-rate Production (R2.0):	4QFY00	
Full-rate Production (R3.0):	TBD	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Defense Medical Logistics Standard Support (DMLSS) program defines and implements a more efficient medical logistics capability for military medical treatment facilities (MTFs) and field units to support health care operations. The DMLSS Automated Information System (DMLSS AIS) is intended to enhance operations by automating manual processes, improving processes already automated, and eliminating existing processes that add no value. Eventually, it will replace eight legacy systems operated by the individual Services. The system will support four major functional areas: (1) materiel management; (2) facility management; (3) equipment and technology; and (4) wholesale. The first three of these are retail medical logistic functions that will be supported by DMLSS AIS at MTFs and field units worldwide; the wholesale functions are supported by DMLSS AIS at only one site—the Defense Supply Center, Philadelphia.

DMLSS AIS is being fielded incrementally, with each release containing both new functions and enhancements to existing functions. The required applications are installed on the user's personal computer and the server software is accessed via existing MTF local area networks. DMLSS AIS supports the ***Joint Vision 2020*** concept of ***focused logistics*** by integrating the medical logistics systems of the Services, reducing MTF inventories of medical and pharmaceutical items, and decreasing the medical logistics footprint. This integration decreases the vulnerability of logistics lines of communications to deployed forces.

BACKGROUND INFORMATION

DMLSS AIS wholesale and retail systems were first deployed to test sites in 1995. Following successful OT&E and correction of a few deficiencies in early 1996, the first major retail increment, DMLSS AIS Release 1.0 underwent OT&E in August 1996. This release began the automation of both the materiel management and facility management processes. OPTEVFOR, the independent OTA, subsequently reported that the system was "potentially" operationally effective and suitable (not all required capabilities were available for testing). Based on the test results, DOT&E recommended the worldwide deployment of Release 1.0. Following successful OT&E of the wholesale system, OPTEVFOR performed a risk assessment, which determined that there was little risk in fielding future enhancements at the single wholesale location. The impact of wholesale operations on DMLSS as a whole would be addressed as necessary during OT&E on the retail portion. DOT&E concurred.

DMLSS AIS Release 2.0 contained upgrades to both the materiel management and facility management modules, and replaced two materiel management legacy systems. In March 1998, DOT&E approved an updated DMLSS AIS TEMP for Release 2.0. Beginning in March 1999, the DMLSS AIS PM installed and tested DMLSS AIS 2.0 at nine developmental testing sites in the United States and overseas. To mitigate risk, OPTEVFOR conducted an OA of a pre-production version at two DT&E sites in August 1999, and determined that Release 2.0 was potentially operationally effective and suitable, and that all of the major deficiencies noted in previous tests had been corrected. A major performance deficiency was noted in the transmission and processing of prime vendor orders, but the problem was quickly corrected by the PM and the Defense Information Systems Agency.

TEST & EVALUATION ACTIVITY

During January 10-21, 2000, OPTEVFOR conducted OT on live DMLSS AIS 2.0 systems at three test sites: Fort Knox, KY; Great Lakes Naval Training Center, IL; and Yokota Air Base, Japan. The general test concept was to: (1) observe users performing typical actions in an operational environment; (2) distribute user questionnaires and conduct user interviews; and (3) review relevant reports, logs, and other documentation. OPTEVFOR satisfactorily resolved 11 of 13 COIs, and partially resolved the remaining two (reliability and facility management performance). The OTA concluded that DMLSS AIS 2.0 is operationally effective and operationally suitable, and recommended that its deployment continue. In June 2000, in San Antonio, TX, OPTEVFOR performed OT on an enhancement to DMLSS AIS 2.0 known as Customer Support on the Web (CSW). CSW enables customers to receive certain medical logistics support by accessing web-based applications. The OTA found that CSW was operationally effective and suitable, and recommended its worldwide deployment. DOT&E concurred.

TEST & EVALUATION ASSESSMENT

DMLSS AIS 2.0, including the recent CSW enhancement, is clearly an improvement over the previous version, and the sooner it is fielded worldwide, the more user data will be available to improve the final increment—DMLSS AIS 3.0. DMLSS AIS is operating successfully and appears to have excellent potential, but several issues need to be addressed. For example, the facility management module, despite its potential as an effective tool for managing facility maintenance, materiel, and construction projects, is not being used extensively or effectively. Based on the OT&E of DMLSS AIS 2.0, DOT&E made recommendations to the PM and the medical logistics functional community for improving DMLSS AIS and the criteria used to evaluate it. Work is now in progress to update both the ORD and the TEMP in preparation for OT&E of DMLSS AIS 3.0, now scheduled for 2001.

THEATER MEDICAL INFORMATION PROGRAM (TMIP)

ASD(HA) ACAT IAM Program		**Prime Contractor**
Total Number of Systems:	TBD	Southwest Research Institute (SwRI)
Total Program Cost (TY$):	$123M	
Average Unit Cost (TY$):	TBD	
Full-rate production:	4QFY01	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Theater Medical Information Program (TMIP) is a tri-Service system that will provide information to deployed medical forces to support all medical functional areas, including command and control, medical logistics, blood management, patient regulation and evacuation, medical threat/intelligence, health care delivery, manpower and training, and medical capability assessment and sustainment analysis. TMIP will perform this service by integrating information from other medical systems, including the Composite Health Care System (CHCS), CHCS II, Defense Blood Standard System, Defense Medical Logistics Standard Support, and TRANSCOM Regulating and Command and Control Evacuation System. TMIP will also integrate other medical applications that have been developed for use during deployment.

TMIP will provide an integrated medical information system to support theater operations by linking all echelons of medical care in support of time-sensitive decisions critical to the success of theater operations. This information will be made available to theater commanders through integration with the Global Command and Control System and Global Combat Support System. In addition, TMIP will support the integration of medical capabilities under a joint concept of operations to assist the medical commander/theater surgeon and support the delivery of seamless combat medical care. TMIP supports the ***Joint Vision 2020*** concept of ***focused logistics*** by integrating medical systems at the theater level to support deployed forces, enhancing the Services' capability to collect, process, and disseminate an uninterrupted flow of information, allowing more efficient protection of lives and resources.

BACKGROUND INFORMATION

Although most health functional areas are well supported by automated information systems within the Military Health System, the Theater Health Services are under supported. To further complicate the matter, there is insufficient interoperability between the existing systems to enable seamless information exchange. The TMIP Mission Need Statement (MNS), which was revalidated in November 1996, documented the needs of the theater CINCs, joint task force commanders, and their medical support activities for data to make informed and timely decisions. Specific deficiencies identified in the MNS include: (1) inadequate command and control systems; (2) insufficient interoperability; (3) limited electronic data collection; and (4) inadequate communications support.

TMIP will be developed incrementally in "blocks" and "builds" of increasing functionality and integration. The military Services are expected to fund their own infrastructure (networks and communications) and computer hardware to host the TMIP software in the theater environment. The program was awarded Milestone I in June 1998. Some of the potential TMIP capabilities were demonstrated at Ft. Gordon, GA, in July 1999, in conjunction with joint exercises GRECIAN FIREBOLT and GOLDEN MEDIC 99. However, the contractor did not deliver the first "build" of the product on schedule in spring 2000, which has delayed operational testing and fielding by about a year. Apparently, the program is now being re-baselined.

TEST & EVALUATION ACTIVITY

No OT&E has been conducted on TMIP. The Joint Requirements Oversight Council approved a Capstone Requirements Document in January 1999 and the Operational Requirements Document for TMIP Block 1 in October 1999. A Capstone TEMP, along with an annex that specifically addresses TMIP Block 1, had been staffed and was ready for OSD approval. IOT&E, to be conducted by the Army Test and Evaluation Command (ATEC), the lead independent OTA, was to have been performed on each of three Block 1 "builds." Build 1.0, to be used initially by the Army, was originally scheduled for a Limited User Test (LUT) in February 2000. Build 1.1, to be used initially by the Navy, was originally scheduled for a LUT in June 2000. Build 1.2, the final and first fully joint version of TMIP Block 1, was originally scheduled for OT&E in October 2000. The latest planning is reportedly for a single pre-IOC version (to be called "TMIP Lite") that will undergo a LUT in February-March 2001. OT&E on the final Block 1 version will not occur until summer or fall 2001.

TEST & EVALUATION ASSESSMENT

TMIP must integrate several existing and developmental systems into a single system that can be easily used by theater commanders and medical personnel in combat environments. Its heavy dependence on the successful operation of the other systems presents additional technical challenges. The functional and operational testing of each TMIP application is supposed to be accomplished prior to delivery to the TMIP PM for integration. This can impose a scheduling problem for TMIP, since a delay in or problem with any application can impact the delivery of that TMIP block. For this reason, the TMIP PM is developing some applications on his own (e.g., medical encounters, immunization tracking) because shared versions from CHCS II are not yet ready. Furthermore, programmatic and OT responsibilities for a "smart card" (called the Personal Information Carrier), have not been completely resolved.

For connectivity, TMIP will depend on existing (but limited) tactical communications systems that will be heavily stressed with fragmented responsibilities. (For example, the transfer of data to the TMIP Interim Theater Data Base is being addressed by the TMIP PM, but not the transfer of data between health care echelons). While some of these situations may be unavoidable, they complicate both operational testing and operational planning and execution. DOT&E is working with the medical functional community, ATEC, and TMIP PM to address all of these issues so that a comprehensive T&E plan can be developed, but this activity has been impacted by the re-baselining of the system. It will be challenging to ensure that the testing environment mirrors the expected theater operational conditions.

PART VII

JOINT TEST AND

EVALUATION (JT&E)

JOINT TEST AND EVALUATION (JT&E)

INTRODUCTION

The Joint Test and Evaluation (JT&E) Program has been in existence for 28 years and is designed to provide quantitative information for analysis of joint military capabilities and potential options for increasing military effectiveness. The program is complimentary to, but not a part of, the weapons acquisition process. A JT&E project brings together two or more Military Departments or other Components to:

- Assess the interoperability of Service systems in joint operations.
- Evaluate improvements in joint technical and operational concepts.
- Evaluate and validate multi-Service testing methodologies.
- Assess performance of interacting systems under realistic joint operational conditions.
- Provide data from joint field tests and exercises to validate models, simulations and test beds.

The JT&E Program is managed by the Director, Strategic and Tactical Systems (D,S&TS). Both D,OT&E and D,S&TS approve JT&E charters as well as test plans. A Senior Advisory Council prioritizes specific JT&E projects after a Defense-wide nomination process and subsequent feasibility studies. The Senior Advisory Council is co-chaired by D,OT&E and D,S&TS and includes representatives from the Joint Chiefs of Staff, the Assistant Secretary of Defense for Command, Control, Communications, and Intelligence and the Military Departments.

The JT&E program provides validated answers to warfighter issues by "doing better with what we have". Its focus remains on identifying realistic, cost-effective, Service-implementable solutions for the programs facing today's warfighter. This year there are nine joint tests. They are:

- Joint Battlefield Damage Assessment (JBDA)
- Joint Close Air Support (JCAS)
- Joint Command and Control, Intelligence, Surveillance, and Reconnaissance (JC2ISR)
- Joint Cruise Missile Defense (JCMD)
- Joint Global Positioning System Combat Effectiveness (JGPSCE)
- Joint Shipboard Helicopter Integration Process (JSHIP)
- Joint Suppression of Enemy Air Defenses (JSEAD)
- Joint Theater Distribution (JTD)
- Joint Warfighters (JWF)

Two programs were finalized this past year: Joint Electronic Combat Testing Using Simulation (JECSIM) and Joint Advanced Distributed Simulation (JADS).

In addition to the ongoing joint tests, this year there are four new feasibility studies. Upon completion of a one-year study period, the Senior Advisory Council will review these studies as potential projects; and some or all will be selected as full joint test projects. The current feasibility studies are listed below:

- Joint Antiterriorism (JAT)
- Joint Unmanned Aerial Vehicles in Battlespace Dominance Operations (JUAV-BDO)
- Joint Aircarft Survivability to MANPADS (JASMAN)
- Joint C4ISR Outcome-Based Integrated Architecture Assessment (JCOBIAA).

JOINT BATTLE DAMAGE ASSESSMENT (JBDA)

Joint Test and Evaluation Program		**Lead Service**
Authorized Manning:	32	Army
Total JT&E Budget:	$15.9M	
Charter Date:	4QFY00	
Completion Date:	4QFY04	

JT&E DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The charter of the Joint Battle Damage Assessment (JBDA) Joint Test & Evaluation (JT&E) is to investigate, evaluate, and improve BDA support to the joint force commander in order to facilitate operational decision-making. Potential improvements will be identified, prioritized, and coordinated with the appropriate commands. JBDA will contribute to the ***Joint Vision 2020*** operational concept of *precision engagement.*

The JBDA JT&E will establish a baseline case by evaluating and documenting current BDA processes and procedures in operational scenarios. Potential deficiencies and opportunities for improvements will be identified. The selected improvements will then be installed and tested in environments as closely aligned with baseline measurements as possible. Analysis of the collected data will be used to evaluate the effectiveness and suitability of the proposed enhancements. For the JBDA JT&E, the Army, Navy, Air Force, Marine Corps and Unified Commands are designated as participating Services/Commands, with the Army designated as the lead Service and executive agent.

BACKGROUND INFORMATION

At the conclusion of *Desert Storm*, BDA was identified as one of the four major intelligence shortcomings. "The BDA process was difficult especially for restrike decisions. BDA doctrine and organization must be determined" (Department of Defense [DoD] Final Report to Congress, *Conduct of the Persian Gulf War*, 1992). "The core analysis problem…centers on tactical battlefield damage assessment, the count of Iraqi tanks, armored personnel carriers and artillery pieces knocked out by the air campaign before the ground offensive kicked off. This was the greatest intelligence failure of the intelligence community during Desert Storm." (Congress, House Oversight and Investigations Subcommittee of the Committee on Armed Services, Intelligence Successes and Failures in Operations Desert Shield/Storm 103 Congress, 1st session, 1993). From Desert Storm lessons learned, it was determined that "The BDA process was difficult especially for restrike decisions. BDA doctrine and organization must be determined. DIA, the Services and the unified and specified commands have begun to institutionalize a BDA structure that will satisfy combatant commanders' requirements." (Department of Defense, *Final Report to Congress of the Persian Gulf War*, April 1992)

Desert Storm outstripped intelligence collection and analysis capabilities, sharply reducing BDA effectiveness. This was further exacerbated by the lack of trained analysts and doctrine that specified BDA production responsibilities. Beginning immediately after the war, DoD addressed the BDA problems in *Desert Storm* by reorganizing targeting activities within DIA. DIA created the Deputy Directorate for Targets (J2-T) as the single national level point of contact for targeting matters, and formed a BDA Working Group under the existing Military Targets Intelligence Committee.

The BDA improvements and changes following *Desert Storm* have been incorporated – at least in part – in subsequent contingencies and operations. The first operation that included enough targets to effectively exercise BDA was *Desert Fox*. With its scripted nature, short duration, and very limited target development, *Desert Fox* was not a vehicle for determining whether or not *Desert Storm* BDA problems were fixed. For example, while *Desert Storm* found that there was a critical need to develop a process for maneuver force BDA, *Desert Fox* emphasized infrastructure and not ground force equipment. CINCCENT stated that he had "seen no seams in the intelligence community in terms of differences of opinion," and that BDA had been rapid, responsive, and well analyzed. BDA worked in *Desert Fox*. The CINC was satisfied, and it appears that members of the intelligence community worked well together. However, *Desert Fox* did not answer the question of whether or not *Desert Storm* BDA problems were fixed; the operations were simply too dissimilar.

The second significant combat operation subsequent to *Desert Storm* was *Allied Force*. This was a North Atlantic Treaty Organization (NATO) air operation against the Federal Republic of Yugoslavia, running from 24 March through 20 June 1999. Federated BDA was used during *Allied Force*. The target sets were federated between USEUCOM (the USEUCOM-established Joint Task Force was designated as the BDA authority) and the NMJIC. As in *Desert Fox*, Federated BDA mitigated some of the coordination problems and appeared to increase BDA responsiveness.

Allied Force and *Desert Storm* shared some common characteristics including some pre-conflict buildup and training; coalition forces; sanctuaries; aircraft and cruise missile strikes; and target development throughout the operation. One of the major differences in the two operations was scale – the numbers of strike aircraft, numbers of sorties, numbers of bases, and geographical area. *Desert Storm* was larger in almost every category. There was also a vast difference in the BDA focus for the two operations. *Desert Storm* emphasized ground force targets, while the same targets were fourth on the *Allied Force* target list. Finally, the tempo of operations was continuous in *Desert Storm* and intermittent in *Allied Force*.

Desert Fox and *Allied Force* illustrated that advances have been made in BDA since Desert Storm. At the same time, these two operations highlight the need for further improvement. Training of analysts is still problematic. Processes and procedures are in place for conducting BDA on fixed targets, but these processes can and should be enhanced to provide BDA in a more timely and accurate fashion to meet the commander's decision cycle. Finally, there has been little focus or effort on improving mobile target BDA since *Desert Storm.*

To address these recurring shortcomings, the Deputy Director, Test and Evaluation (DDT&E), under the Director, Test, Systems Engineering and Evaluation (DTSE&E), Office of the Secretary of Defense (OSD), directed the Joint Battle Damage Assessment (JBDA) Joint Feasibility Study (JFS) in June 1999. The Army was designated as the lead Service, and responded quickly to the SAC's guidance, moving the JFS sponsorship to the Training and Doctrine Command (TRADOC) and assembling the initial staff.

TEST & EVALUATION ACTIVITY

The JFS team began by modeling the current 'perceived as-is' BDA process and documenting known problems. The feasibility study team conducted a thorough problem characterization of BDA. The characterization was conducted through research, polling of subject matter experts (SMEs) from all of the Services, the Joint Staff, and the unified commands, and the efforts of a joint working group (JWG). After compiling inputs and reviewing the JBDA characterizations, the JWG adopted a revised problem statement as the basis for the JBDA JT&E approach. A series of briefings began to the Joint Staff, the combatant commands, the Services, and the Test and Evaluation (T&E) agencies from the action officer through the director, and, in some cases, the Commander in Chief (CINC). These briefings obtained guidance and support, ensured all parties that the JBDA effort was on track, and provided a venue for the JFS team to raise the awareness level of current BDA processes and identified problems.

As the JFS team progressed through the study, a detailed analysis methodology was developed and potential test venues were reviewed. Issues and measures were selected to focus on areas requiring the most urgent attention. Under the guidance of the Technical Advisory Board (TAB) and General Officer Steering Committee (GOSC), the Test Approach, Schedule and Venues were selected.

TEST & EVALUATION ASSESSMENT

The 'perceived as-is' generic BDA process has been documented in IDEF0 format. This model has been providing the basis for the construction of the test dendrite and for framing our structured analysis, as well as for the Integrated Data Requirements List (IDRL) and Data Management and Analysis Plan (DMAP). The IDRL and DMAP will form the backbone for all future test activity. In addition, three JBDA analysts deployed to Osan Air Base, CP Tango and Camp Humphreys to participate in the 26th Ulchi Focus Lens (UFL 00) Command Post Exercise in the Republic of Korea. They used this opportunity to observe the BDA process, and to gather information necessary to build a draft IDEF0 model for Korea. US Forces Korea is currently reviewing this JBDA-developed draft IDEF0 model. The draft was eagerly received, and is already being used by the USFK Ground Component Command BDA Cell as an aid in visualizing their BDA processes.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

Potential recommendations based on JBDA problem characterization and research include:

- ***TTP Development.*** Documentation of the BDA process will provide the necessary basis for determining what TTPs currently exist, how the process works, and what is needed. This "snapshot" of the current BDA process supports the evaluation of current TTPs and refinements to existing doctrine. JBDA will prepare a compendium of data that supports JT&E findings and outcomes concerning the operational concepts and TTPs for both fixed and mobile target BDA as well as a combat effectiveness model that fulfills the JFC's requirements. The documentation will address problem areas identified during the JT&E and will recommend changes to enhance combat effectiveness. The users of these data will be the Joint Staff, combatant command staffs, JTFs, the Service and component staffs, and the commanders and staffs of operational units at all echelons.

- ***Training.*** The JT&E team will identify and document potential enhancements to BDA training. This will cover the training of individuals, units, component commands and Service staffs in BDA and BDA-related collection management and coordination. The team's findings and recommendations will be documented and provided to J2-T for the combatant commands, the Services, and other OSD and joint organizations for inclusion in the Universal Joint Task List (UJTL) CJCSM 3500.04. Curriculum enhancements will be recommended to DIA, joint and service schools.

- ***Systems.*** JBDA results will be the basis for providing recommendations to J2-T, Combatant Commands, and the Services for developing or modifying systems to enhance BDA. JBDA will also investigate the use of COTS/GOTS systems (primarily interactive software programs with imagery) such as that used in industry training to improve analyst training. The test team will identify problems in areas such as the interoperability of communications and data systems and the commonality and effectiveness of tactical situation displays. The test team will prepare inputs that document such problems and provide recommendations to correct them. The test team will provide these inputs to J2-T for the Joint Staff, OSD agencies, and the Services. These inputs will provide a basis for preparing requirement documents such as Mission Need Statements (MNS) and Operational Requirements Documents (ORD).

- ***Documentation of Operational Concepts and Tactics, Techniques, and Procedures***. The documentation of the BDA process baselines will be of explicit value. JBDA will prepare a compendium of data that supports JT&E findings and outcomes concerning the operational concepts and TTP to effectively conduct BDA. The documentation will address problem areas and will recommend changes to enhance combat effectiveness. The users of this data will be the Joint Staff, combatant command staffs, the Service staffs, and the commanders and staffs of operational units. This data may also serve as a benchmark baseline of targeting transactions to support future improvement efforts.

JOINT CLOSE AIR SUPPORT (JCAS)

Joint Test and Evaluation Program		Lead Service
Authorized Manning:	24	Air Force
Total JT&E Budget:	$22M	
Charter Date:	4QFY97	
Completion Date:	4QFY03	

JT&E DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

Joint Close Air Support (JCAS) is a DoD Joint Test and Evaluation (JT&E) program chartered by OSD to assess the current capabilities of U.S. forces to conduct joint close air support (CAS) in both day and night conditions. The JCAS Joint Test Force (JTF) will also test and recommend potential enhancements to improve joint CAS effectiveness. To do this, the JTF will employ multi-Service air and ground equipment and personnel in realistic combat training scenarios. The test will address two critical issues:

1. What is the joint CAS baseline effectiveness?

2. What changes to Joint CAS Tactics, Techniques, and Procedures (JTTP), equipment/systems, and training increase effectiveness compared to the baseline?

The primary JCAS test site is the National Training Center (NTC) at Ft. Irwin, CA. The JCAS JTF conducts testing at NTC on a non-interference basis with regularly scheduled brigade-level training sessions conducted by rotating Army operational brigades against a permanent opposing force stationed at NTC. The Air Warfare Center at Nellis AFB, NV provides CAS attack and forward air controller airborne sorties.

BACKGROUND INFORMATION

The last DoD joint test of CAS JTTP was completed more than a decade ago. Since then, new weapons and support systems technologies such as Global Positioning System, low-observability, secure communications, advanced electronic warfare devices, and night-vision devices have been adopted by both ground and air forces. As interactions among ground and air support forces evolved, corresponding JTTP for effective CAS developed in an *ad hoc* manner. Service manpower levels combined with an increased operational tempo have potentially adversely affected CAS training and operational readiness. JCAS is intended to benchmark CAS operational effectiveness today and offer improvements for the future.

TEST & EVALUATION ACTIVITY

JCAS was chartered in 1997 following a feasibility study. In the first year, the JTF completed and OSD approved the JCAS program test plan. The JTF coordinated and completed signed memoranda of agreement with all necessary support units and arranged operations facilities. At the suggestion of the Joint Chiefs of Staff, the JCAS charter was expanded in 1998 from *Joint Night CAS* to *Joint CAS* to address both day and night CAS operations. Initial test operations began with a mini-test conducted in November 1998 at NTC to determine the contribution of visual control of CAS aircraft in daylight, medium altitude conditions. JCAS field testing began in earnest in March 1999. Since then, the JCAS JTF has completed data collection, reduction, and analysis of nearly 40,000 data elements addressing over 200 joint CAS measures. The JTF published the *JCAS Interim Report* in 2000, focusing on the day joint CAS baseline. The focus of future testing will be on the night joint CAS baseline and evaluating proposed joint CAS enhancements. Future test venues will include the Marine Corps Air Ground Combat Center (MCAGCC) at Twentynine Palms, CA.

TEST & EVALUATION ASSESSMENT

JCAS is a needed test at the right time. As our weapon systems become more capable and potential enemy forces become steadily more capable, U.S. forces must capitalize on the strengths of leading-edge technology. While many weapon systems embody impressive technical functions, their actual employment on the battlefield as part of a greater strategic picture will determine the outcome of future combat. By leveraging off the large-scale and realistic brigade-level combat training at NTC and other training venues like MCAGCC, JCAS promises to provide realistic information that can be used to direct future research and development activity toward efforts with the greatest potential benefits.

JOINT COMMAND AND CONTROL, INTELLIGENCE, SURVEILLANCE AND RECONNAISSANCE (JC2ISR)

Joint Test and Evaluation Program		Lead Service
Authorized Manning:	55	Air Force
Total JT&E Budget:	$19.1M	
Charter Date:	4QFY00	
Completion Date:	1QFY05	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The objective of this Joint Test and Evaluation (JT&E) program is to improve Joint operations by providing recommendations to enhance Joint C2ISR tactics, techniques, and procedures (TTP), operational concepts, training and systems. JC2ISR will enhance the Joint warfighter's ability to utilize diverse national, theater, and tactical collection sensors and dynamically focus them to identify, locate, track, and engage high value, mobile surface targets. Recommendations resulting from JC2ISR will significantly improve the Joint Force Commander's ability to integrate assigned organic and higher echelon platforms and sensors in a coordinated (cross-cued) and cooperative (simultaneous) collection strategy. The results of this JT&E will provide decision-makers significantly improved C2ISR tasking, processing, exploitation, and dissemination (TPED) to support time critical targeting and are applicable to all Joint warfighters. This effort is designed to enhance a CinC's capability to achieve *full spectrum dominance* through *precision engagement.*

BACKGROUND INFORMATION

Unified Commands, Services, and National Intelligence Agencies currently devote significant resources in an effort to improve Joint warfighter's ability to engage time critical targets (TCTs). Recent military operations (e.g., Operations Desert Storm, Desert Fox, and Allied Force) confirm our inability to identify, locate, track, and engage fleeting, mobile targets. Simply put, enemy mobile targets are vulnerable for a shorter period of time that it takes to engage them using current procedures. A major contributor to this limitation lies in C2ISR TPED shortfalls conducting dynamic operations. Lessons learned from these military operations identify requirements for highly discriminate targeting information and avoidance of collateral or unintended damage despite poor weather and adversary countermeasures. The unaided human decision and C2ISR TPED cycle are too slow to respond to fleeting targets that can "*shoot and scoot.*" Although we possess some ability to preplan countermeasures against TCTs using Intelligence Preparation of the Battlespace (IPB), uncertainty as to the specific what, where, when, how, and why of enemy employment typically places TCT detection, identification and location inside the time cycle for preplanned operations.

The Office of the Director, Strategic and Tactical Systems (ODS&TS), Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics (OUSD AT&L) chartered JC2ISR to employ multi-Service and other Department of Defense (DoD) agency support, personnel and equipment to investigate, evaluate, and make recommendations to improve the operational effectiveness of Joint C2ISR. Specifically, JC2ISR will test and evaluate the Joint Task Force and Components' ability to dynamically task and re-task ISR collection platforms and sensors and their ability to process, exploit, and disseminate combat information to support time critical targeting. The JC2ISR JT&E program will baseline current C2ISR processes used to prosecute TCTs, identify ISR platform and sensor tasking, processing, exploitation, and dissemination deficiencies, and identify opportunities for Joint C2ISR improvements.

TEST & EVALUATION ACTIVITY

The JC2ISR JTF is currently drafting its Program Test Plan (PTP) and will soon begin constructing a Detailed Test Plan (DTP) for its first field test. With support from CENTCOM, the JC2ISR JTF is mapping on the information flow, physical processes, and collection management processes occurring within theater to support time critical targeting. The test force is now selecting specific Joint C2ISR enhancements for approval to be applied and tested in September 2001. The JC2ISR JTF is working with other complimentary initiatives to avoid duplication of effort and waste of scarce resources.

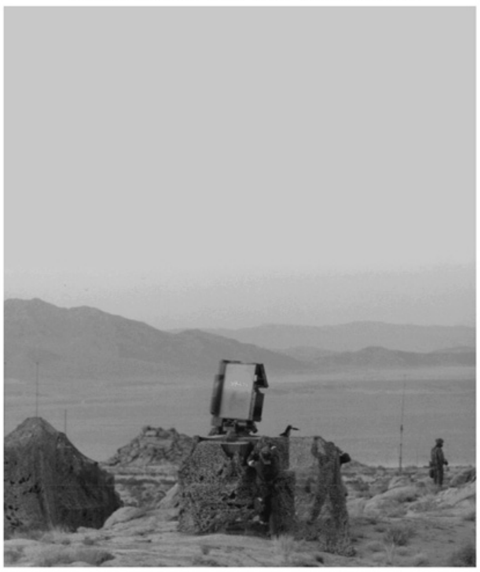
TEST & EVALUATION ASSESSMENT

The JC2ISR JT&E program meets the stated purposes of the OSD JT&E Program and the Services and CinCs continue to support the project. Resources and planning are on track to support field testing in September, 2001.

JOINT CRUISE MISSILE DEFENSE (JCMD)

DETECT AND TRACK

IDENTIFY



ALLOCATE

ENGAGE

Joint Test and Evaluation Program		**Lead Service**
Authorized Staffing (FY01-04):	24	Air Force
Total JT&E Budget:	$17.3M	
Charter Date:	4QFY99	
Completion Date:	4QFY04	

JT&E DESCRIPTION AND CONTRIBUTION TO JOINT VISION 2020

OSD chartered the Joint Cruise Missile Defense (JCMD) JT&E to employ multi-service and other DoD agency support, personnel, and equipment to investigate, evaluate, and improve the operational effectiveness of joint defenses against cruise missiles. The JT&E will identify a baseline capability by evaluating and documenting current JCMD processes and procedures in realistic operational scenarios. The JT&E will identify and select potential enhancements to the JCMD process and will test those enhancements in environments as closely aligned with baseline measurements as feasible. The Full-Dimensional Protection pillar of Joint Vision 2010 addresses the need to protect US forces from the very technologies that the US is attempting to exploit. The JCMD JT&E will address the number-one priority of the Full-Dimensional Protection pillar: countering air and missile threats.

The Joint Cruise Missile Defense mission area is the integrated efforts of a Joint Integrated Air Defense System (JIADS) to counter a cruise missile threat. The JT&E will address all five elements of the JIADS cruise missile kill chain: Detect, Track, Identify, Allocate Assets, and Engage.

BACKGROUND INFORMATION

With the aid of a Joint Working Group, the JCMD staff formulated the following problem statement on JCMD for the JT&E: "*The Joint Integrated Air Defense "Family of Systems" capability to meet the cruise missile threat has not been fully explored*."

The term "Family of Systems" refers to the collection of individual systems that make up the JIADS. The family includes command, control, and communications assets (E-3 aircraft, E-2 aircraft, ground systems, etc.), shooter assets (fighter aircraft, Patriot, Aegis, etc.), and all the other principal systems resident in a theater that can perform one or more JIADS functions. The JCMD JT&E will test current (2001) JIADS JCMD capability, identify problem areas, and then test implemented improvements and enhanced JIADS JCMD capability (2003). The selected methodology for the JT&E includes a mix of joint field tests with operational units involved in the joint air defense mission and of multipurpose, interactive simulations. This test approach provides the ability to assess the effectiveness of a joint force's ability to counter the cruise missile threat, identify critical problem areas, define potential enhancements, and assess the effects of the enhancements on the mission effectiveness of a joint integrated air defense force. The JTF will develop and leave behind a series of legacy products designed to institutionalize the work and results of the JT&E.

TEST & EVALUATION ACTIVITY

The JCMD Joint Test Force (JTF) will conduct a series of field and simulation tests to assess the current and enhanced JIADS JCMD capability. Phase 1 of the JT&E was a risk-reduction effort consisting of one mini-test (MT) to solidify the data collection approach, train the team, and assess the ability of the JIADS component systems to conduct the JCMD mission. Phase 2 consists of one full-up field test [FT-1]) and one major virtual simulation test (ST-1), augmented by constructive simulation assessments. Phase 2 efforts will identify the effectiveness and shortfalls in JIADS JCMD capabilities and provide the opportunity to identify potential enhancements, both in terms of improvements to JIADS component systems as well as improvements to current operational tactics, techniques, and procedures (TTP) and concept of operations (CONOPS).

The first JCMD JT&E field activity, the MT, occurred in Feb-Mar 2000 in conjunction with the All Service Combat Identification Evaluation Team (ASCIET) annual evaluation. Air defense was a major objective of the ASCIET evaluation that featured participation by a JCMD-supplied cruise missile surrogate as a part of the opposition forces. The JTF met all MT objectives and demonstrated the capability to integrate with the ASCIET evaluations, coordinate cruise missile surrogate operations, and collect data. The JTF is engaged in analyzing the MT data and will produce the MT final report in December 00. Subsequent field tests will also use the ASCIET evaluations as the venue of choice.

For Phase 2, the JTF has scheduled FT-1 in conjunction with the Aug-Sep 01 ASCIET evaluation. This test will address all elements of the JIADS kill chain and will, together with data from MT, provide the basis for calibration of the JCMD virtual simulation architecture. JCMD plans to coordinate participation of two types of cruise missile surrogates in the evaluation. The JTF will coordinate development of a JCMD simulation architecture to conduct the first major simulation test (ST-1) in the Jul 02 time frame at the Virtual Warfare Center (VWC). ST-1 will use a combination of linked constructive and interactive models and will focus on PACOM scenarios, threats, force structure, etc. These first tests will provide the data to enable an assessment of current (2001) JIADS capability in the CMD role.

Phase 3 of the JT&E will consist of a major field test (FT-2) and a major simulation test (ST-2). FT-2, to be conducted in conjunction with ASCIET 03 in Feb-Mar 03, will provide an assessment of the effects of the enhancements to the JIADS JCMD capability and the FT-2 data will provide a further calibration for the JCMD simulation architecture. The JTF will use ST-2 to explore the potential benefits to further JIADS enhancements and to assess the impacts of alternate scenarios. ST-2, scheduled for Oct 03 at the VWC, will again focus on the PACOM area of responsibility and will use a PACOM scenario, threat lay-down, etc. appropriate to the 2003 time frame.

This robust demonstration approach will serve to firmly entrench the JT&E-developed methodology as the primary tool for assessing the effectiveness of JIADS forces engaged in JCMD. The major customers for JCMD JT&E legacy products will be the CINCs and Services.

TEST & EVALUATION ASSESSMENT

The JCMD JT&E focuses on two critical operational issues:

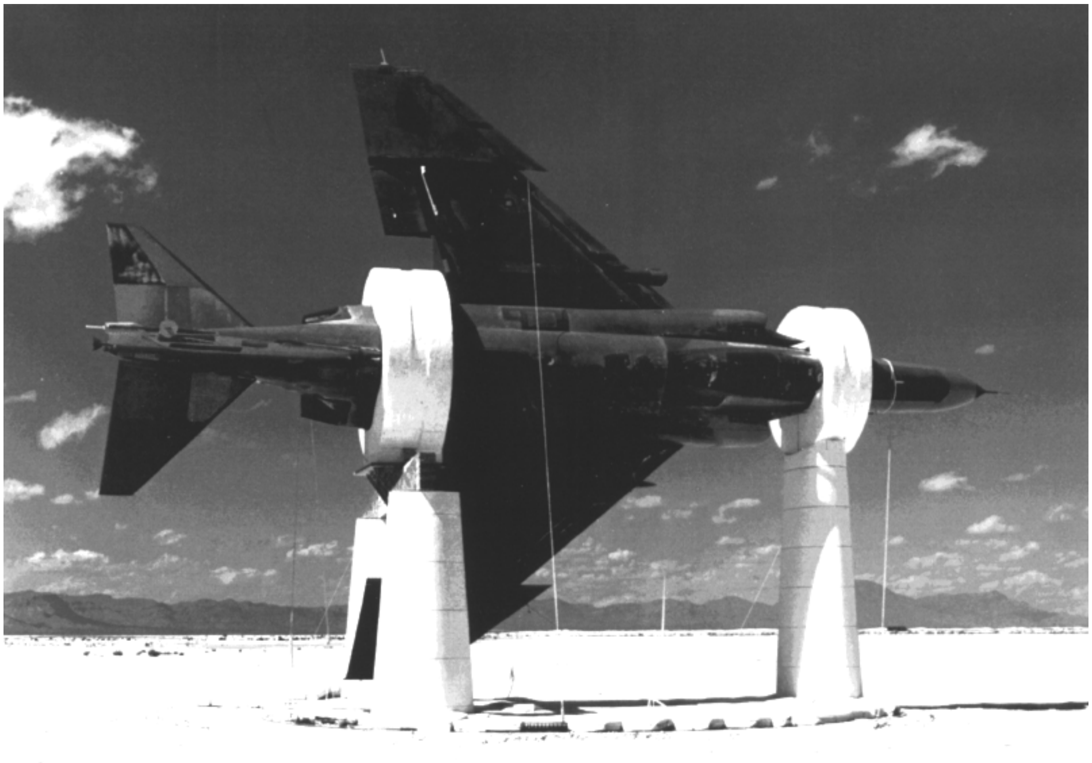
1. What is the current (2001) JIADS capability to defeat cruise missiles?

2. How will near-future (2003) enhancements improve current capability as force multipliers?

Using the dendritic process, the JCMD staff developed a series of sub-issues, measures, and data elements structured around the kill chain processes to address the two issues. The resulting JT&E dendritic structure provided the logical framework for defining and refining the JT&E test design and identifying the required data collection and analysis processes. As designed, the JT&E directly addresses both issues, both quantitatively and qualitatively. The specific effectiveness measures calculated for Issue 1 will quantify the current JIADS JCMD capability. Comparison of these same measures calculated for Issue 2 will provide an assessment of the worth of the tested enhancements. Additional qualitative assessments by operational subject matter experts will assist in identifying needed changes to TTP and CONOPS, as well as further potential JIADS enhancements.

The JTF will publish a test report approximately six months following each major activity. This will provide near-term feedback to the warfighters to use in interim improvements to TTP and CONOPS as well as for inputs to their requirements processes. The JCMD JT&E final report and briefing is scheduled for May-Jun 2004.

JOINT ELECTRONIC COMBAT TEST USING SIMULATION (JECSIM)



Joint Test and Evaluation Program		**Lead Service**
Authorized Manning:	10	Navy
Total JT&E Budget:	$14.656M	
Charter Date:	3QFY96	
Completion Date:	4QFY00	

JT&E DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

Historically, electronic combat has made extensive use of simulation in the development and testing of new systems. It is becoming impractical to address all the needs of testing defensive countermeasures in open-air tests for reasons of complexity, safety, and security, cost, and availability of threat systems. As this trend continues, there is increased need for test and evaluation of the simulations themselves. The Joint Electronic Combat Test Using Simulation (JECSIM) Joint Test and Evaluation (JT&E) was chartered to begin such an assessment. The joint test was to determine the full range of engagement features needed to assess both performance and model accuracy for semi-active missiles that use radio frequency energy reflected from fighter, bomber, and helicopter aircraft being tracked by a powerful illuminating radar. This required the use of laboratory tests, Hardware-in-the-Loop (HITL) facilities, captive carry tests, ground mounted seeker facilities, signature measurement, fuse testing, and full-up open-air tests to address two issues:

1. The degree to which existing Modeling and Simulation (M&S) could be used to predict OT&E and DT&E results from semi-active missile engagements in ECM environments.

2. The sensitivity of probability of kill (P_k) calculations to changes in the end game geometry parameters predicted by M&S.

The tests focused on the SA-6 semi-active missile system and the ALE-50 (towed decoy) and ALQ-165 (Advanced Self-Protect Jammer) ECM suites. The M&S that was tested focused on Defense Intelligence Agency validated threat representations integrated into the Joint Model and Simulation System (JMASS) suite. The JMASS seeker model lacked the capability to simulate responses to the AH-64 onboard Electronic Combat (EC) system (ALQ-211), and the helicopter model further lacked a complex, dynamic signature model. In addition to addressing issues of M&S prediction quality, the measurements had value in their own right for ongoing programs. This JT&E was designed to improve the test and evaluation of ECM systems, which are part of the effort to provide ***full-dimensional protection*** to our troops.

BACKGROUND INFORMATION

This effort grew out of longstanding difficulties with open-air range testing of ECM systems. By 1993, a Flyout Model Working Group was meeting to define a common model set. In 1994, discussions focused on active versus semi-active missiles for consideration. The feasibility study for JECSIM grew out of these efforts, leading to chartering in August 1996. Fuse testing and modeling, P_k sensitivity analysis, and other start-up activities were conducted in 1997.

Activities during 1998 included the first phase of measurements at the HITL facility, preparation of detailed test plans for the captive carry measurements, and the second phase of HITL measurements. A Technical Advisory Group was formed in summer 1998 to address analysis issues. The group performed a technical review of the methodology for using test data to correlate with digital models. In this context "correlate" had a specific meaning—referring to the degree to which a large number of missile flight parameters "correlate" between the test and the simulation.

During 1999, JECSIM completed Ground Mounted Seeker (GMS) testing and the Captive Flight Test (CFT), and documented results from previous testing. In addition, JECSIM conducted simulation runs with JMASS 3.2M and JMASS 98 environments. The GMS test provided seeker interaction with real targets, with and without ECM. Targets of interest included the B-1B with the ALE-50 towed decoy and the F/A-18 with the AN/ALQ-165 ASPJ (Airborne Self-Protection Jammer). The CFT provided the most realistic clutter environment. Targets of interest included the B-1B and F/A-18. JECSIM completed the final reports for SA-6 live fire testing, laboratory testing, HITL testing, and Radar Cross-Section testing. M&S developments—the preparation of JMASS compliant threat models and the conversion to JMASS 98—led to more delays for JECSIM than from the physical measurement program.

With the threat models running in JMASS 98, rapid progress was made. JMASS 98 proved to be much more efficient than earlier versions because it allowed faster turnaround and greater ease of debugging modeling and data problems. The M&S work duplicating the lab and HITL measurements was completed at the end of FY99. HITL measurements and the related M&S work clearly demonstrated the impact of threat system variability (by serial number) on blue system performance. By serial number variability we mean the item-by-item difference in performance for a collection of systems of the same type. AFOTEC had previously demonstrated similar variability for a command guided missile in support of the ECM technique evaluation for the B-1B Defensive Systems Upgrade. These results conclusively established the importance of requiring robust designs of electronic warfare systems rather than point solutions.

TEST & EVALUATION ACTIVITY

The modeling of the Captive Flight Test and the Ground Mounted Seeker Test was completed in 1QFY00. A utility analysis assessed, somewhat subjectively, the utility of M&S in a variety of regimes.

Diagnostic testing with the two CFT seekers and the instrumentation package was conducted in November. This test revealed the source and cause of some CFT and GMS test data problems for the F/A-18 and provided an opportunity to capture the waveform from the onboard EC system.

Six JECSIM Integrated Product Team members and another 26 evaluators from Army, Navy, and Air Force components contributed to the utility evaluations of the simulation. The utility analysis considered functional (what must be represented), fidelity (accuracy of correlation), and operational (user-related issues) aspects for each of the activities of test planning, prediction, evaluation, and extrapolation of results. The simulation proved adequate for prediction of response to the off-board ECM and non-ECM cases for the bomber, but its utility for the fighter was limited. Utility for the helicopter was further limited due to lack of an adequate signature model and inability to simulate response to the onboard technique.

JECSIM developed a method and carried out an "extension analysis." This is a method for "extending" test results to different test conditions using validated M&S. The "extended" results are themselves quantitative predictions, with quantitative confidence measures for those predictions. The methodology is elaborate and its description is beyond the scope of this report. Nevertheless, it appears quite valuable in its intended use. In addition, it offers the possibility of using M&S to treat variability in threat systems (by serial number) to design robust electronic warfare solutions effective over the range of the variability.

TEST & EVALUATION ASSESSMENT

JMASS 98 proved to be a much more useful tool in T&E than earlier versions of JMASS. Its use dramatically improved the JECSIM team's ability to execute M&S work.

JECSIM results conclusively demonstrate the need for robust electronic warfare designs based upon an informed assessment of threat system variability. Currently, existing M&S tools can be of great use here. Ideally, validated models based upon exploited systems would be used. However, with careful use, even models developed in the absence of fully exploited systems can support design and test of robust electronic warfare systems.

N-point scattering center models require significant resources to produce, are accurate for either far or near-field applications, and may require very large data sets. They and the software to produce them should be verified and validated.

Developing the extension analysis was an ambitious undertaking that shows promise. *First*, it provides a methodology for validated simulations of threat systems to be used to make quantitative predictions of blue jammer effectiveness against the actual threat systems, accompanied by a quantitative confidence level. These predictions can be extrapolated outside the region where the simulation was validated, and the confidence level informs the user of the likely accuracy of the predictions under the assumption that the extension outside the measurement region does not sample untested features of either threat or electronic warfare system. This was demonstrated for a few cases, but it remains to be seen how universal the application will be. Extension analysis may impact the area of variability. The extension analysis offers an approach to validating models and making predictions in cases where the serial number variability of the threat system leads to dramatic differences in system performance, especially at end game. Essentially, this methodology allows one to validate a system model against detailed test data when serial number variability leads to dramatic differences in field test outcomes. The validation comes with a confidence measure, which can be computed for any point in the operating space of the system. This is of tremendous potential value for designing robust systems.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

Modeling and Simulation can have great value when coupled with physical measurements as part of an integrated T&E program.

The difficulties encountered by JECSIM in comparing modeling and simulation and measurement results show that for optimal value M&S efforts must start early. Ideally, there would have been an M&S infrastructure largely in place at the start of the measurement program.

There should be a standard approach for M&S application during requirements planning, system acquisition, and operation and support phases.

The added value of M&S comes over the life of a program and is not primarily a short-term benefit.

Consider a mix of simulation types, not just detailed, emulative EC capable seeker models for the support of future EC T&E programs.

Evaluate methods to shorten timelines for M&S development and integration with EC T&E programs.

Results of the end game analysis suggest that miss distance Measures Of Effectiveness should be used (instead of P_k) to evaluate EC systems during OT&E. P_k sensitivity analyses should be used to define miss distance criteria that can be safely and reliably tested using accurate instrumentation.

To reduce risk and explore conditions that cannot be tested, the T&E community needs constructive M&S that is reliable, flexible, readily available, and credible with a relevant validation history.

JOINT GLOBAL POSITIONING SYSTEM COMBAT EFFECTIVENESS (JGPSCE)

Joint Test and Evaluation Program		Lead Service
Authorized Manning:	42	Air Force
Total JT&E Budget:	$30M	
Charter Date:	4QFY99	
Completion Date:	2QFY04	

JT&E DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Joint Global Positioning System Combat Effectiveness (JGPSCE) Joint Test Force is chartered to evaluate the impact of electronic warfare targeted against global positioning system (GPS) receivers in joint operations. GPS provides highly accurate, real time, passive, common-reference grid position and time information to military and civilian users worldwide. GPS enables the military forces to determine their position, velocity, and time. GPS will: (1) enhance command and control and coordinate battle tactics and support; (2) engage in strategic and tactical warfare; (3) maneuver efficiently on the battlefield; (4) provide accurate and timely fire support; and (5) facilitate combat service support operations. In addition, knowledge of the exact position and time is essential to reconnaissance and intelligence missions. GPS provides the precision, velocity, and time elements of ***information superiority***, and serves as the cornerstone of the warfighter's ability to execute the ***Joint Vision 2020*** concept of ***precision engagement***.

BACKGROUND INFORMATION

JGPSCE's Problem Statement:

"*Warfighters are increasingly reliant on GPS. The impact of the loss or degradation of GPS capabilities, and the ability to operate despite that loss or degradation, has not been systematically tested or evaluated in a joint operational environment.*"

In July 1999, the Office of the Under Secretary of Defense, Director, Test, Systems Engineering and Evaluation, chartered the JGPSCE joint test and evaluation (JT&E) to address three issues:

- What is the impact of GPS vulnerabilities on the effectiveness of joint operational missions requiring precision engagement?
- What changes in joint tactics, techniques, and procedures or system-level mitigation techniques improve or maintain joint operational effectiveness in the event of GPS electronic warfare and electromagnetic interference?
- What test methodologies can be employed to characterize GPS vulnerabilities in future acquisition and integration programs?

TEST & EVALUATION ACTIVITY

JGPSCE JT&E will conduct three phases of testing, implemented by four tests events, each examining an increasing level of warfare. The three phases of warfare are: (1) Small Scale Contingency; (2) Limited Engagement; and (3) Major Theater War. Each level represents a major concern for DoD planners today, as well as presents unique problems in maneuver, engagement, and logistics/force protection. All are highly dependent on secure, high-speed communications.

In order to provide a manageable scope of testing, JT&E is limiting the evaluation to the arena of precision engagement of interdiction targets. This decision was taken for several reasons. First of all, there are other JT&E activities looking at time critical targets (Joint Suppression of Enemy Air Defenses and Joint Warfighter), logistics (Joint Theater Distribution), and force protection (Joint Combat Search and Rescue). Second, the operational concept of precision engagement can be embodied in the two joint tasks of reconnaissance and interdiction, giving JGPSCE a sound doctrinal base. Finally, precision engagement can be applied to reconnaissance and interdiction exercises in a complete sensor-to-shooter chain, crossing the boundaries of both the Joint Targeting Cycle at the operational level and Tactical Mission Functions at the tactical level.

Each of the three test phases is designed to provide information relating to key information upon which warfighters can base subsequent decisions. Each phase will use jamming of GPS in the open air to be as realistic as possible. Each phase will look at the impact of GPS electronic warfare and electromagnetic interference by comparing baseline performance to performance after the electronic warfare and electromagnetic interference occurs. Each phase will also introduce mitigation techniques and procedures developed during test planning, and look at the ability of troops and commanders to operate in a GPS degraded or denied environment. Thus, each of the three phases will be immediately useful to theater commanders and DoD.

Phase 1 testing consists of two live test events, GYPSY ALPHA and GYPSY BRAVO, at the tactical level of warfare. These tests focus on determining GPS electronic warfare and electromagnetic interference vulnerabilities and mitigations for few-on-few engagements during small-scale contingencies. Each of the two live tests in Phase 1 will concentrate on portions of the sensor-to-shooter architecture.

Phase 2 testing will consist of one live test event, GYPSY CHARLIE. The focus of this test will be on integrated system-of-systems tactical-level mission performance and integrated system-of-systems operational-level mission performance during limited engagement operations.

Phase 3 testing will consist of a single test, GYPSY DELTA, which will evaluate integrated tactical and operational level systems and warfighters performing missions during a major theater of war scenario.

GYPSY ALPHA testing began with trial 1 on October 30, 2000, and will continue through November 18.

TEST & EVALUATION ASSESSMENT

The JGPSCE Joint Test Force is expected to help theater commanders in four ways:

- First, the impact of degrading or denying GPS will be evaluated. This should settle a lot of controversy over the effects of GPS signal loss or degradation and provide a badly needed baseline for future planning and acquisitions.

- Second, there is a great deal of anecdotal evidence which suggests that existing equipment can be used more effectively to minimize the effects of electronic warfare targeted against GPS. This JT&E should help institutionalize better training and awareness in the field.

- Third, commanders and soldiers will learn the leading indicators of GPS electronic warfare or electromagnetic interference, and differentiate between them, making operational and tactical responses quickly and with greater confidence than possible today.

- Finally, this JT&E should result in a greater appreciation of the need to fully understand GPS capabilities, dependencies, and vulnerabilities in establishing system requirements, finalizing designs, developing concepts of operations, and executing realistic tests. The outcome should be new systems that use GPS more effectively and appropriately. Once fielded, system operators should better understand the role of GPS in their equipment, incorporate signal protection into their design and use, and immediately recognize whether GPS is being degraded or denied.

CONCLUSIONS, RECOMMENDATIONS AND LESSONS LEARNED

Assessing the vulnerability of GPS-based systems to the effects of electronic warfare, and determining appropriate actions to prevent or negate those effects, is one of the most important tasks confronting DoD. It is imperative that the Department makes every effort to ensure the successful conduct of JGPSCE, as well as ensure that the lessons learned are incorporated into current and future systems.

JOINT SHIPBOARD HELICOPTER INTEGRATION PROCESS (JSHIP)

Joint Test and Evaluation Program

Authorized Manning (Mil/Gov/Civ)	8/2/36
Total JT&E Budget:	$22.5M
Charter Date:	4QFY98
Completion Date:	4QFY03

Lead Service

Navy

Sponsor

Naval Air Warfare Center
Aircraft Division, Patuxent River, MD

JT&E DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Joint Shipboard Helicopter Integration Process (JSHIP) Joint Task Force was chartered to develop and evaluate a standard process for the integration of multi-Service rotorcraft, aircrews, and embarked units aboard air-capable U.S. Navy ships. The JSHIP Joint Task Force conducts flight tests, critical measurements, engineering analyses, and simulations to provide recommended changes to Joint tactics, techniques, and procedures; training syllabi; and rotorcraft/ship designs that will enhance safe, rotorcraft/ship interoperability. Only Special Operations Forces (SOF) and Army helicopters will be scheduled for use during these tests. Expected products from the JSHIP program include expanded launch and recovery flight envelopes for 12 helicopter/ship combinations and ship certification for 12 specific helicopter/ship pairs. The JSHIP program supports the ***Joint Vision 2020*** operational requirement of ***dominant maneuver*** for Joint Task Force operations.

BACKGROUND INFORMATION

The JSHIP Joint Test and Evaluation (JT&E) program was chartered by OSD on July 22, 1998, following the completion and acceptance of a Joint Feasibility Study initiated in June 1997. All Services and Unified Commands are designated as participants, with the Navy as the lead service and executive agent for the program. A General Officers Steering Committee was established to provide the Joint Test Director a forum for senior-level counsel and advice. The JSHIP program has completed an Analysis Plan for Assessment, a Program Test Plan, and individual Detailed Test Activity Plans for each of the Dedicated At Sea Tests conducted during FY00. DOT&E and DD(DT&E), S&TS provided co-signature approval of the Program Test Plan on September 30, 1999.

The program hosted warfighter conferences with multi-Service representation to identify test assets and more closely identify current issues as viewed by the operational forces. The program also sent test team members to observe Navy/Marine Corps at sea exercises as the initial effort to baseline the "standard operations and practices" currently in existence.

TEST & EVALUATION ACTIVITY

The program continues to coordinate with personnel from the NASA Ames Vertical Motion Simulator (VMS) group to develop and integrate the JSHIP Dynamic Interface Modeling and Simulation System (DIMSS) software with the VMS software to create a high fidelity, dynamic cockpit trainer for UH-60A/LHA training simulations. DIMSS will also provide the full tool set for air-wake modeling and wind-over-the-deck analyses. The DIMSS Validation, Verification, and Accreditation Plan has been prepared for review and approval by the Naval Air Warfare Center.

Five Dedicated At Sea Tests (DASTs) were initially planned for FY00. Two tests were cancelled due to higher priority tasking of intended test articles. These tests are being rescheduled in FY01. Each test evolution includes land-based Electromagnetic Interference, Compatibility, Vulnerability (EMI/EMC/EMV) testing of the helicopter, pre-sail conferences, and the DAST dynamic interface testing of a fully instrumented helicopter aboard ship. DAST-1 was conducted from November 1-4, 1999, with an instrumented Army UH-60A and a non-instrumented Army CH-47D aboard USS Saipan LHA 2. DAST-1 was focused on data measurement/collection for the UH-60A to support the DIMSS development/integration effort. DAST-2 was conducted in March/April 2000. A fully instrumented SOF AMH-6 and a non-instrumented Army MH-60K were tested aboard USS Essex LHD 2. DAST-3 involved a fully instrumented Army UH-60L and a non-instrumented Navy SH-60F aboard CV-64, the Constellation. The Navy SH-60F was a last minute substitution due to scheduling difficulties. This test occurred in May 2000, and included launch and recovery operations from the Number-3 elevator. Ship air-wake at sea testing was conducted in September 2000 to collect additional air-wake data for the UH-60A aboard USS Peleliu LHA 5. This additional data was necessary to support the DIMSS/VMS integration effort.

TEST & EVALUATION ASSESSMENT

DOT&E supports the JSHIP plan of action for joint test and evaluation and the proposed approach to use the integrated DIMSS software package and VMS assets to support pilot training and helicopter/ship dynamic interface analyses. The DAST-1 Final Report, the Dynamic Interface Test Report for the UH-60A Aircraft Aboard USS Saipan LHA 2, and the UH-60 & SD-2 Spotting Dolly Preliminary Static Compatibility Assessment Report were released for distribution in mid-September 2000. Final Reports for subsequent FY00 DAST evolutions have not been released.

The two reports outlined several areas of concern. The single tail wheel design, common to the UH-60A/L/Q, EH-60A/L, MH-60K/L, HH-60G and future Navy CH-60S, has the characteristic of the wheel axle plane not remaining parallel to the deck when the wheel caster is either left or right of the aircraft longitudinal axis. The SD-2 Spotting Dolly tail wheel lifting arms are designed for tail wheel axles that remain parallel to the deck. Dolly maneuvers require tail wheel caster angular rotation that could adversely impact the structural integrity of the landing gear and airframe. The dolly is in common use aboard large decked ships, both on the flight deck and on the hangar deck. A "General Use Naval Aviation Hazard Report" was filed in June 2000 to all concerned Services and recommendations made to conduct a thorough evaluation of the system to clearly define limits of the dolly maneuvers.

Additional deck handling problems and adverse weather rotor tie down problems were identified for the CH-47D.

The test tempo has provided heavy volumes of data and proven to be a major task for the JSHIP program to process, analyze, prepare individual final test reports, and adhere to the anticipated schedule. An internal review of program objectives and schedules identified the need to extend the program for an additional year. Authorization to extend the program through FY03 was granted on June 10, 2000. DOT&E concurs with the JSHIP program effort to test and document helicopter/ship pair interoperability to support future safe, joint Service operations.

JOINT SUPPRESSION OF ENEMY AIR DEFENSES (JSEAD)

<u>Joint Test and Evaluation Program</u>		**<u>Lead Service</u>**
Authorized Manning:	51	Air Force
Total JT&E Budget:	$23.3M	
Charter Date:	3QFY96	
Completion Date:	4QFY01	

JT&E DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The Joint Suppression of Enemy Air Defenses (JSEAD) Joint Test and Evaluation (JT&E) was chartered by OSD to characterize the reactive JSEAD targeting process, baseline current capabilities, quantify element contributions to that process, identify deficiencies, and test and evaluate potential improvements. The program issue, as developed through analysis of warfighter concerns, is: *Do end-to-end JSEAD targeting process enhancements improve reactive, localized JSEAD effectiveness?* Three separate test issues address specific parts of the program issue:

- **Test Issue 1:** "Do the proposed changes to Intelligence, Surveillance, and Reconnaissance (ISR) collection management improve reactive JSEAD effectiveness over the current baseline?"

- **Test Issue 2:** "Do the proposed changes to intelligence processing improve reactive JSEAD effectiveness over the current baseline?"

- **Test Issue 3:** "Do the proposed changes to Command and Control (C^2) improve reactive JSEAD effectiveness over the current baseline?"

JT&E will result in recommendations for improving the end-to-end reactive JSEAD effectiveness of U.S. forces and reducing enemy Integrated Air Defense System (IADS) capabilities.

This JT&E is designed to support the development and test and evaluation of systems with the mission of ***precision engagement.*** In addition, end-to-end engagement capability of Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C^4ISR) systems supports ***information superiority*** and the electronic warfare systems support ***full-dimensional protection***.

BACKGROUND INFORMATION

Warfighting commanders require the capability to conduct effective JSEAD operations to sever an enemy's IADS by targeting key command and control and air defense assets. JSEAD operations apply pre-planned (pre-emptive) and opportune (reactive) targeting, whereby commanders employ both destructive (seek out and destroy) and disruptive (temporarily deny, degrade, deceive, delay or neutralize) force application methods. Since the Gulf War, the JSEAD strategy has emphasized pre-emptive targeting and destructive force application methods. However, the surface-to-air missile threat is becoming more technologically sophisticated and mobile, and therefore more difficult to target pre-emptively. With fewer dedicated JSEAD assets to perform reactive JSEAD in this increasingly hostile air defense environment, there is a need to improve the Joint Force Commander's ability to conduct reactive JSEAD more effectively and efficiently using existing Service assets.

The JSEAD Joint Test Force (JTF) effort to accomplish its charter began with characterizing existing JSEAD processes in Joint and Combined Air Operations Centers worldwide. The JTF placed specific emphasis on ISR, intelligence processes, and command and control. This allowed the JTF to develop a generic model of JSEAD targeting processes suitable for testing and ensured that test results could be implemented worldwide.

The JSEAD JTF performed two field tests in 1998: (1) a live-fly exercise (LIVEX 98) employing multi-Service participants, Red Flag resources, during the conduct of a Green Flag Exercise at Nellis AFB; and (2) a Computer-Assisted Exercise (CAX 98) at the Air Force Battlestaff Training School at Hurlburt Field, FL. Each test included an initial set of trials to establish a baseline for evaluation of the associated test issue and a second set of trials to allow measurement of enhancement impacts.

Tests planned for 1999 were cancelled due to priority commitments of key test assets to support combat operations against Iraq and the Former Republic of Yugoslavia. The JTF provided valuable findings from JSEAD's 1998 tests to decision makers responsible for those combat operations.

TEST & EVALUATION ACTIVITY

The ongoing experiences in the Balkans, when combined with the detailed 1998 test results, clearly attested to the need to continue JT&E through charter completion despite the loss of 1999 test opportunities. The SAC rated JSEAD as its top priority JT&E and approved an extension to September 2001 to allow for completion of a final LIVEX in August/September 2000.

Following the extension approval, the JT&E completely revised the Program Test Plan and Data Management and Analysis Plan to reflect the resultant program level changes. An OSD Interim Program Review and two General Officer Steering Committee meetings were also completed to ensure that JT&E was properly focused and in touch with Warfighter needs. Additionally, an Interim Report was published and two highly successful Data Management Exercises were completed in conjunction with the U.S. Air Force Weapons School Mission Employment exercise as risk reduction rehearsals for LIVEX 00.

SEAD's final test, LIVEX 00, was conducted at Nellis AFB from August 26-September 8, 2000, using Green Flag as its test bed. The test featured over 1,000 aircraft sorties in a realistic air defense environment, a rich ISR collection capability, advanced intelligence processes, and the exercise of command and control over the joint forces. The JTF meticulously instrumented all participants to support rigorous analysis and meet original JT&E charter objectives. The JTF will complete reconstruction, analysis and reporting of LIVEX 00 as well as its overall test program in FY01.

Upon completion of its analysis, the JTF will offer recommendations for improved JSEAD tactics, techniques, procedures and doctrine. The JTF will produce recommendations for training, command and control, and intelligence processes that warfighters will be able to implement immediately. The JTF will also identify any remaining mission needs that cannot be met with existing mission resources.

TEST & EVALUATION ASSESSMENT

The JTF's first test, CAX 98, was conducted from March 1-8, 1998, and focused on time-critical targeting processes within a Joint Air Operations Center (JAOC). Twelve test trials were conducted. By using an approved Southwest Asia scenario with personnel from CENTCOM, CENTAF, ARCENT, and NAVCENT, the test was able to effectively emulate JSEAD related functionality of a JAOC operating on a theater conflict scale. The test was designed to characterize and measure enhancements in information management, battlespace awareness tools, and time-sensitive targeting processes. The collection process was viewed as fully successful and demonstrated the feasibility of combining both testing and training venues within a Blue Flag type facility.

The first LIVEX test, LIVEX 98, was conducted from April 20-May 1, 1998. The test was conducted in an operationally realistic environment for characterizing ISR baseline and measuring the impact of ISR enhancements on information completeness, timeliness, and accuracy. Analysis of LIVEX 98 test data provided valuable insights to commanders and key decision makers responsible for combat operations, including OPERATION NORTHERN WATCH and OPERATION ALLIED FORCE. LIVEX 98 data also provided useful inputs to the design and execution of subsequent test activities.

LIVEX 00 was conducted from August 26-September 8, 2000. The test redefined JSEAD baseline capabilities and tested and evaluated potential improvements to the reactive JSEAD process through the implementation of improvements to the ISR, intelligence processing and fusion, and C^2 processes. Fifteen trials were completed in LIVEX 00. The data are currently undergoing trial reconstruction and analysis.

LIVEX 00 was OSD's most complete and realistic test of modern reactive JSEAD targeting to date. LIVEX 00 utilized the facilities provided by the Nellis Range Complex and Red Flag for test and training, but augmented them with more threats, a current intelligence team, a combat operations division, and additional instrumentation. Organizations throughout the Department of Defense, as well as National agencies, supplied ISR assets, coverage, and participants. Joint ISR contributors included U-2, EP-3, Rivet Joint, National systems, Joint Surveillance Target Attack Radar System (JSTARS), Predator, and associated processing stations. Intelligence analysts from the ISR providing organizations used an array of feeds including TIBS, TDDS, TADIXS-B, TRIXS and USMTF messages. Intelligence analysts processed imagery using a variety of systems including Joint Services Work Station, Joint

Targeting Workstation, and Predator video. Intelligence also cross-cued participating systems and used manual processes as well as Generic Area Limitation Environment Lite to fuse multiple reports. Intelligence products were provided to the Combat Operations Division at the collateral level using Radiant Mercury.

In LIVEX 00, the JAOC Combat Operations Division tasked reactive JSEAD targeting using voice messages, Rapid Precision Targeting System, and data links. Airborne Elements of the Theater Air Control System, including E-3, Airborne Battlefield Command and Control Center, JSTARS, and Rivet Joint provided additional command and control including threat warning, tasking, voice relay and data link messages.

LIVEX 00 Combat Forces included airborne alert aircraft dedicated to reactive JSEAD targeting with standoff weapons (USAF F-15Es with AGM-130s and USMC F/A-18Ds with JSOW). Suppression aircraft included EA-6Bs, EC-130s and F-16CJs. JSEAD operations in LIVEX 00 were set in a realistic scenario with other aircraft assigned primary combat missions of Counter-air and Interdiction. A Battlefield Coordination Detachment and a Naval/Amphibious Liaison Element directed notional JSEAD engagements by Army Tactical Missile System and Navy Tomahawk Land Attack Missile respectively. These were the only notional weapons systems in the test.

By leveraging ongoing operational exercises (Blue Flag and Green Flag.), this JT&E is avoiding costs otherwise associated with a fully dedicated test program.

JOINT THEATER DISTRIBUTION (JTD)

Joint Test and Evaluation Program		Lead Service
Authorized Manning:	62	Army
Total JT&E Budget:	$16.5M	
Charter Date:	4QFY98	
Completion Date:	2QFY03	

SYSTEM DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

Joint Theater Distribution (JTD) is the system that enables the geographic combatant commander to deploy, employ, sustain, and re-deploy assigned forces and non-unit materiel and personnel to carry out missions assigned to his command. The system is a network of nodes and links tailored to meet the logistic requirements of the military force during peacetime, contingency, or wartime operations. The purpose of the JTD Joint Test and Evaluation (JT&E) is to examine, standardize, and streamline the theater distribution pipeline nodal processes to enhance theater distribution effectiveness and efficiency, thereby reducing customer wait time.

This four-year test is designed to quantitatively/qualitatively measure the effectiveness and efficiency of the DoD distribution system in an effort to enhance theater distribution through the application of better business practices to the processes within the in-theater distribution nodes. JTD JT&E focuses on in-theater distribution, but will include an examination of other distribution pipeline operations, both strategic and tactical, when they impact theater distribution operations. The effort is designed to enhance a CINC's capability for ***full spectrum dominance*** through ***focused logistics.***

BACKGROUND INFORMATION

Recent military and humanitarian operations highlighted difficulties in managing the in-theater distribution of assets, the related information flows, and the integrated management processes necessary for the geographic CINC to execute his directive authority for logistics support. Simply stated: To provide the "right support to the right customer at the right time, the first time." The shear volume of materiel to be moved through the theater distribution nodes during the early phases of deployment and sustainment operations overwhelms the node's ability to execute distribution. These nodes are where unique Service systems and units must hand off cargo and materiel in a seamless fashion to avoid backlogs and bottlenecks. Experience has shown that this is where the overall distribution process tends to break down. This test addresses the nodes' underlying business processes and focuses on their improvement - not on the nodal resources required to execute distribution within each node.

The JTD JT&E project was chartered by OSD on September 8, 1998. The JTD JT&E is being conducted over a four-year period using a team of contractor and Service personnel. In year one, the JTD JT&E conducted visits to multiple sites within the PACOM and EUCOM Areas of Responsibility (AORs). The visits focused on mapping the "As Is" discrete nodal physical processes, information flows, and management processes occurring within the Aerial Ports of Debarkation (APOD), Seaports of Debarkation (SPOD), Hub/Advanced Logistic Site (ALS), Trailer Transfer Points (TTP), Terminal Transfer Units (TTU) and the Customers. This information is being used to develop test articles for each of the planned test treatments, and to build models unique to each distribution node type in a CINC's AOR. In the second year, "As Is" mapping in the CENTCOM AOR was completed and the first test treatments were applied in PACOM and EUCOM. During the third year of the test, "As Is" mapping in the U.S. Southern Command (SOUTHCOM) will be conducted and test articles will be developed as part of the test treatments. In the fourth year, the JTD JT&E will formulate the best joint business process for each in-theater distribution node type. These improved distribution node types will then be implemented and tested in the PACOM, EUCOM, CENTCOM, and SOUTHCOM AORs.

TEST & EVALUATION ACTIVITY

The Program Test Plan was approved on 7 March 2000. The "As Is" mapping of the theater distribution process was completed in the CENTCOM AOR (April/May 2000) and SOUTHCOM AOR (September 2000). The first test treatments were applied in PACOM (March 2000) and EUCOM (August 2000). Data collection from those first treatments is ongoing at this writing.

TEST & EVALUATION ASSESSMENT

The resources and planning for the JTD JT&E are adequate to meet the stated purposes of an OSD JT&E program. Data continues to be collected and analyzed. The CINCs and the Services continue to support the project. Participation by the field activities visited by the JTD JT&E personnel has been outstanding. Analysis of the "As Is" mapping has identified several potential areas ripe for efficiencies to be gained. Early test treatments have been targeted toward the more obvious efficiencies to be gained. The full impact of test treatments will not be confirmed until the test is complete in FY03.

JOINT WARFIGHTERS (JWF)

Joint Test and Evaluation Program		**Lead Service**
Authorized Manning:	36	Army
Total JT&E Budget:	$722.4M	
Charter Date:	4QFY97	
Completion Date:	1QFY02	

JT&E DESCRIPTION & CONTRIBUTION TO JOINT VISION 2020

The charter of the Joint Warfighters (JWF) Joint Test and Evaluation (JT&E) project is to investigate, evaluate, and improve the operational effectiveness of joint operations against time-sensitive surface targets (TSST) by evaluating and documenting current time-sensitive surface target processes and procedures in realistic operational scenarios. Potential improvements will be identified, prioritized, and coordinated with the appropriate commands. JWF will contribute to the ***Joint Vision 2020*** operational concepts of ***precision engagement*** and ***full-dimensional protection***.

JWF established a baseline by evaluating and documenting the current TSST processes and procedures in operational scenarios. Potential deficiencies and opportunities for improvements were identified. The previously coordinated potential improvements were installed and tested in environments as closely aligned with baseline measurements as possible. Analysis of the collected data is being used to evaluate the effectiveness and suitability of the proposed enhancements.

For Joint Warfighter JT&E, the Army, Navy, Air Force, Marine Corps, and unified commands are designated as participating Services/commands, with the Army designated as the lead Service and executive agent.

BACKGROUND INFORMATION

Targeting in general, and the prosecution of time-sensitive targets in particular, was often cited as deficient in nearly all reports on the Persian Gulf War. Three examples of this issue are as follows:

- On February 26-27, 1991, a large portion (possibly 50 percent) of the Republican Guard Forces Command (RGFC) was allowed to escape across the Euphrates River. The RGFC escaped because of confusion and a breakdown in coordination.

- The first Army Tactical Missile System (ATACMS) ever fired in combat was delayed hours, in part, while appropriate clearance was coordinated by all of the various nodes. While procedures were refined during the course of the war, it was not unusual for subsequent firings to be delayed up to two hours for clearance.

- The lack of success in the engagement of SCUD missile launchers.

To address this shortfall in our warfighting capability, a Joint Feasibility Study was directed to conduct a thorough problem characterization on the prosecution of time-sensitive targets in a joint force.

DOT&E and the Deputy Director, Systems Assessment, approved the Program Test Plan with the Data Management Analysis Plan in December 1998.

TEST & EVALUATION ACTIVITY

JWF participated in Ulchi Focus Lens (UFL 99) Command Post Exercise (CPX) in the Republic of Korea in August 1999 to baseline the joint TSST prosecution process. Fifty-seven personnel deployed to Osan Air Base, Command Post (CP) Tango, Camp Humphreys, Red Cloud, Yongin, Pohang, and the USS Blue Ridge to stand side by side with the U.S. and Republic of Korea players and gamers to collect data on the joint prosecution of time-sensitive surface targets.

In October of 1999, Joint Warfighters began preparations for the UFL 00 test activity of the enhanced joint TSST process in the Korean Theater of Operations by analyzing the data collected during UFL 99. Enhancements were developed for implementation within the framework of the processes documented in the UFL 99 baseline test activity. Throughout the remainder of 1999 and through May 2000, JWF personnel worked with theater personnel from U.S. Forces Korea (USFK) (J3 and J6) and the Service components to refine, install, and test the enhancements in theater. The enhancements that were installed for testing during UFL 00 were:

- TSST Information Network. USFK's TSST operations consist of functional positions arrayed throughout various component operations and intelligence cells. While functional positions offer varying levels of support for each TSST event, they are required to provide their respective inputs and must be able to coordinate with one another. This network provides functional positions the ability to coordinate laterally and share information quickly and accurately.

- TSST Guide. This guide is to be used as a ready reference of theater and component Tactics, Techniques, and Procedures (TTPs), capabilities, and reference materials. It reinforces existing training for augmentees as they "spin-up" on theater procedures and provides a primer for newly assigned personnel to understand the lateral coordination needed to integrate component warfighting capabilities. It consolidates theater TTPs into an easy-to-understand format and specifies what targeting elements and operational factors are critical to successful TSST prosecution. The TSST Guide will also contain a concept of operations (CONOPS) on how to use each collaborative tool.

- TSST Web Page and Server. The TSST Web Page is an extension of, and is linked to, the USFK/J3-OP web server to provide customized, near real-time information posting; specifically, component battle rhythm data and target information relating to TSST prosecution. The TSST Web Page displays TSST events, changes to the weaponeered, sourced Single Prioritized Integrated Target List (SPITL), and mobile target updates. The server permits shared applications, allowing multiple sources the capability to post information; e.g., mission report data and battle damage assessment.

- Collaborative Tool. USFK/J6-IS has authorized the use of Microsoft NetMeeting version 2.11. As an interim enhancement, NetMeeting will be incorporated by the TSST Information Network to support component lateral coordination until DoD implements a permanent collaborative solution. The TSST Information Network provides the TSST functional positions the capability to coordinate in a more accurate, complete, and timely manner. The current concept of operation focuses on multi-point chat capability between 20 positions and "whiteboarding" between intelligence positions at the releasable to South Korean personnel level.

- Secure Conferencing. This provides the TSST Information Network a secure, bridged communication capability. Its primary functions are to provide lateral notification of TSST execution, notify members of the TSST Information Network of a collaborative session, and serve as backup tool for lateral coordination.

During June and July 2000, JWF served as consultants to train theater personnel on the use of the enhancements, and to assist them in the development of standing operating procedures and CONOPS. Data recording and analysis equipment for the UFL 00 exercise were also installed and tested during this period.

The TSST Network enhancements were configured on 20 stations at various centers. The network resided on the Global Command and Control System–Korea (GCCS-K) Wide Area Net (WAN) and included the use of NetMeeting as a collaborative tool and the TSST Web Page. To support the use of the enhancements, a NetMeeting set-up and user guide was prepared and given to the positions along with a TSST Guide outlining the TSST process and enhancements. The TSST Guide was also available on the TSST Web Page.

UFL 00 was not the only joint exercise in which JWF participated. Blue Flag 00-2 was another excellent opportunity for JWF to baseline the joint targeting process, this time for U.S. Central Command (USCENTCOM). Blue Flag 00-2 was held from March 1-9, 2000, with exercise play running Mar 5-8, 2000. Blue Flag 00-2 was a CPX to train the USCENTCOM joint air operations center battlestaffs with limited involvement and support from the other USCENTCOM Service components. The exercise used a limited Southwest Asia scenario with ground forces in fixed, defensive posture. The exercise was hosted at Hurlburt Field, FL, with distributed support from:

- USCENTCOM & Navy Component Central Command (NAVCENT): MacDill AFB, FL
- U.S. Army Forces Central Command (USARCENT): Ft. McPherson & Ft. Gordon, GA
- USMC: Marine Corps Air Station Miramar, CA

JWF deployed 28 people to observe the exercise and record data on the players' TSST processes and procedures. Immediately following Blue Flag 00-2, USARCENT conducted Lucky Warrior to train the battlestaff in a ground offensive scenario. Two JWF personnel stayed over at Ft. McPherson to observe Lucky Warrior.

JWF also began preparations for data collection at Internal Look in November 2000 by attending the Internal Look 2000 Initial Planning Conference in December 1999, Mid Planning Conference in May 2000, and Master Scenario Event List Conference in June 2000.
JWF participated in a third joint working group for *Joint Publication 3-60 (Joint Doctrine for Targeting)* as a technical review authority.

TEST & EVALUATION ASSESSMENT

During UFL 00, use of the network enhancements increased as the exercise continued with the Air Combat Command and the Korea Combined Operations Intelligence Center being the predominant users. Some technical problems occurred but did not significantly affect TSST operations. Preliminary feedback indicates wide acceptance of the enhancements and their positive contribution to the process by making the exchange of information easier, faster and providing a record for follow-up. Both the CJ3 and the Deputy Commander In Chief expressed satisfaction with the enhancements, their desire to retain and grow the enhanced capability, and a willingness to assume future operational costs. Preliminary observations indicate that the enhancement package in the TSST process contributed to reducing joint TSST target ambiguities and increasing cross-component coordination in the prosecution of joint TSSTs. The effort is considered a successful operation.

During Blue Flag 00-2, the overall planning and execution of the test went well, and data and observations were gathered. The quicklook team confirmed that data were collected on 74 different TSSTs during the exercise, 56 of which were quality threads between multiple player nodes.

Several changes were incorporated based on the lessons learned in the UFL 99 and Blue Flag 00-2 after action reports. In turn, these reports will be key documents that enable us to continue to improve our operations as we prepare for later testing at Internal Look 00.

As a product of research into the lessons learned from Operation Desert Storm, the JWF team published a monograph discussing the most notable wartime problems encountered in the joint environment when prosecuting TSSTs. These examples of the challenges incurred in conducting real-time targeting and the joint application of firepower will provide the Services with a relevant exemplar that can be used as an established point of departure in the training of battle managers. The monograph was published this year in *Defense Analysis* in the United Kingdom.

RECOMMENDATIONS

Recommendations based on JWF findings include:

- **Documentation of Operational Concepts and Tactics, Techniques, and Procedures (TTPs).** The documentation of the TSST process baselines will be of explicit value. There is near total agreement that documentation is a potential problem in our warfighting abilities. One hypothesis of JWF is that shortfalls in performance are related to the shortfalls in documentation. In addition to providing the comparative foundation for enhancement testing, the documentation and promulgation of the TSST processes will allow commanders an opportunity for objective scrutiny and provide trainers with the building blocks for tomorrow's curriculum. JWF will prepare a compendium of data that supports JT&E findings and outcomes concerning the operational concepts and TTP to effectively prosecute TSSTs. The documentation will address problem areas and recommend changes to enhance combat effectiveness. The users of this data will be the Joint Staff, combatant command staffs, the Service staffs, and the commanders and staffs of operational units. This data may also serve as a benchmark baseline of targeting transactions to support future improvement efforts.

- **Validation of and Input to Newly Approved Joint Doctrine and TTPs.** JWF will recommend changes to specific joint publications that should be made. JWF could produce requirements for a completely new publication. JWF will prepare recommendations and provide them to the Joint Staff, Services, and agencies as needed.

- **Recommendations for Joint Training.** JWF has identified potential enhancements to the training of individuals and Joint Task Force staffs as well as component commands/Service staffs in prosecuting TSSTs. As a result of the test activities, the team has gained expertise in the methods and processes needed to enhance joint operational training. Recommendations may concern proficiency standards, changes in the mix and echelons of units, assessment and feedback methods, and training methods involving live, constructive, and virtual simulations. Joint schools, as well as Service training schools, may receive recommendations on how to enhance their curriculum. These recommendations can also be incorporated into joint- and Service-hosted battle manager exercises to train battlestaffs on how to coordinate the efforts of multiple components.

- **Recommendations for System Requirements.** JWF results will be the basis for providing recommendations to the Joint Staff and the Services for developing or modifying systems to enhance the effectiveness of prosecuting TSSTs. It is anticipated that the JT&E team will identify problems in areas such as the interoperability of communications/data systems and the commonality and effectiveness of tactical situation displays. The JT&E team will prepare inputs that document such problems and recommendations on correcting them.

- **Recommendations for Joint Force Command Organization.** There are no joint doctrines that describe how a joint force should be organized for the command and execution of fires. JWF expects to document the various organizational structures currently in use along with the positive attributes and problem areas associated with each example.

- **Modification to the Universal Joint Task List (UJTL CJCSM 3500.04).** JWF will provide input to the UJTL, which currently contains no operational or tactical tasks for targeting TSSTs. As described earlier, the criticality of time-sensitive surface targeting warrants specific tasks in the premier joint training task list.

- **Additions to JCS-Approved Joint Definitions.** JWF will develop new and revised joint terminology definitions for incorporation into Joint Publication 1-02, Department of Defense Dictionary of Military and Associated Terms. These definitions will improve the joint lexicon by clarifying the current terminology and defining new terms to better describe a JFC's responsibilities when conducting time-sensitive surface targeting.

PART VIII

NON-MAJOR SYSTEMS

OT&E

NON-MAJOR SYSTEMS OT&E

In accordance with Section 139, paragraph (b)(3), Title 10, United States Code, the Director, Operational Test and Evaluation (DOT&E) is the principle senior management official in the Department of Defense to "monitor and review all operational test and evaluation in the Department of Defense." This includes Operational Test and Evaluation (OT&E) on smaller, non-major acquisition systems. Although several non-major systems, such as those directly affecting major systems and those specifically directed by Congress, are under direct oversight of DOT&E, the OT&E of most non-major systems are controlled by the Service Operational Test Agency's (OTAs).

The Service OTAs are responsible for OT&E on hundreds of small programs. The Army Test and Evaluation Command is currently working on 483 Acquisition Category (ACAT) III or below programs and Navy COMOPTEVFOR retains 155. The Air Force Test and Evaluation Command (AFOTEC) retains 127 ACAT III programs under their cognizance. This is in addition to the numerous ACAT III programs managed by the Air Force's Air Combat Command (ACC), Air Mobility Command, and Air Warfare Center. None of the Service OTAs are adequately funded for this work. With priority often going to the higher profile major acquisitions, the OTAs must balance many competing demands for very scarce resources.

These small programs represent some of the best examples of integrated Test and Evaluation (T&E), demonstrating very effective processes to more rapidly field new military equipment. Often, these processes are aggressive applications of the Secretary's themes we have urged for five years now—early involvement by the operational testers, combining DT with OT, and combining testing and training. We are using successful examples from smaller programs to encourage the larger major system acquisitions to take advantage of the benefits of these themes.

One example of non-major system OT&E reported this year was Medium Shelter System (MSS)/Family of New Portable Shelters (FOPS). This was the only non-major system T&E activity in support of a full-rate production decision reported by AFOTEC in FY00. A description of the T&E by AFOTEC follows.

SYSTEM DESCRIPTION

MSS is an expandable, soft wall modular shelter system supported by an aluminum frame covered with vinyl fabric. MSS provides 1,500 square feet of floor space to accommodate large work or storage areas in a bare base environment. MSS has two large vehicle doors, two personnel doors, and six windows. The shelters are designed to be transportable by air, land, and sea, and compatible with C-130 aircraft and the 463L cargo loading system.

TESTING CONCEPT/METHODOLOGY

This Qualification Operational Test and Evaluation (QOT&E) was conducted by employing MSS in a variety of scenarios. Real-world operations (power production, welding, aircraft generation equipment, and vehicle maintenance) were conducted in two shelters, while direct comparison testing was conducted on two other test articles. Twenty assembly cycles were performed on a fifth MSS. Testing was also done to ensure MSS was compatible with existing bare base equipment.

NOTABLE RESULTS

MSS was found to be operationally effective and suitable. Twenty-two deficiencies were documented during QOT&E. All were resolved by ACC and the program office prior to production. Most deficiencies were related to the vehicle doors. MSS also exceeded the Key Performance Parameter of a 25 percent airlift sortie reduction over the existing system. MSS reduced the airlift footprint by 66 percent.

CONTRIBUTION/INFLUENCE QOT&E HAD ON THE PRODUCTION DECISION

MSS QOT&E ensured that the best product possible was fielded.

LESSONS LEARNED/TEST LIMITATIONS

Recommend all data analysis be completed prior to the Deficiency Review Board (DRB). The DRB was held immediately following the field events, and not all data analysis was complete. Upon completion of the data analysis, additional deficiencies were discovered that needed to be coordinated with key offices—thus delaying publication of the final report.

The following tables document some of the other non-major systems OT&E activities conducted by the Service OTAs. (These tables are limited to those T&E activities reported in FY00 that were intended to support full-rate production decisions.)

NAVY					
SYSTEM NAME	**ACAT**	**TEST DATES**	**EFFECTIVE**	**SUITABLE**	**SURVIVABLE**
HARM Blk III	III	12/98-9/99	Yes	No	N/A
S-3 Critical Avionics Upgrade	IVT	8/99-10/99	Yes	Yes	N/A
C-2A Aircraft Block Upgrade	IV	9/99-4/00	Yes	Yes	N/A
H-60 Armed Helo	III	8/99-12/99	Yes	Yes	N/A
Tomahawk Cruise Missile	III	10/99-12/99	Yes	Yes	N/A
Joint Warning and Reporting Network	III	11/99-12/99	N/A DT Assist	N/A	N/A
Joint Services Imagery Processing System	III	12/99	Yes	Yes	N/A
Ship's Signal Exploitation Equipment	IVT	11/99-12/99	Yes	Yes	N/A
Cooperative OUTBOARD Logistics Update	III	12/99	Yes	No	N/A
Financial Air Clearance Transportation System	IVT	12/99-2/00	No	No	N/A
Acoustic Rapid COTS Insertion	III	7/99-11/99	Potentially EOA	Potentially	N/A
Closed Loop Degaussing	IVT	2/00	Yes	Yes	N/A
Submarine High Data Rate Antennae	IVT	2/00-3/00	N/A DT Assist	N/A	N/A
Submarine LF/VLF Receiver	IVT	3/00-4/00	Yes	Yes	N/A
Marine Mammal System	IVT	7/00	N/A DT Assist	N/A	N/A
Thin Line Towed Array	III	8/00	N/A DT Assist	N/A	N/A
Acoustic Intercept Receiver	III	8/00	N/A DT Assist	N/A	N/A
Non-Gasoline Burning Outboard Engine	III	9/00	N/A DT Assist	N/A	N/A
Acoustic Rapid COTS Insertion	III	2/00	N/A DT Assist	N/A	N/A

ARMY					
SYSTEM NAME	**ACAT**	**TEST DATES**	**EFFECTIVE**	**SUITABLE**	**SURVIVABLE**
12 Gauge Shotgun Non-Lethal Ammunition	III	4/99-6/99, 9/ 99	YES	YES	No issues
25 mm, Armor-Piercing Fin Stabilized Discarding Sabot-Tracer (APFSDS-T), M919 Cartridge with Swiss Munitions Extruded/Impregnated (EI)-Propellant	IV	6/98-6/99	YES	YES	N/A
3-KW Tactical Quiet Generator (TQG)	III	11/98-8/99, 4/99-5/99	YES	YES	YES
Air & Missile Defense Work Station (AMDWS) Software Version 1.0	III	Continuous Evaluation	YES	YES	YES
Type I High Mobility Multi-purpose Wheeled Vehicle (HMMWV) Cargo Bed Cover (CBC)	III	5/95-12/95, 5/99-8/99, 11/99-12/99	YES	YES	YES
Jt Firefighter Integrated Response Ensemble (J-FIRE) Glove	III	10/99, 1/00	YES	YES	YES
Modernized Demolition Initiators XM151 & XM152 Boosters and XM152 Inert Booster	IV	7/99-10/99	YES	YES	YES
Movement Tracking System (MTS)	III	4/00	YES	YES, with limitations	NO
Palletized Load System Container Roll-In/Out Platform (PLS-CROP)	IV	Various FY98/99	YES	YES	N/A
Portable Vehicle Arresting Barrier (PVAB)	III	Various FY99	YES	YES	E3 survivable; other survivability N/A
XM95 Rifle Launched Non-Lethal Munition (RLNLM)	III	Various FY99, 1/00	YES, with caveat	YES	No issues

MARINE CORPS					
SYSTEM NAME	ACAT	TEST DATES	EFFECTIVE	SUITABLE	SURVIVABLE
Joint Service Combat Shotgun	III	4/00	Yes	Yes	N/A

Notes:

1) MCOTEA and OPTEVFOR do not breakout survivability for separate treatment. Survivability is addressed as a component of Operational Effectiveness.

2) Operational Effectiveness and Suitability findings above were reflective of the system at the time of test. The system presented for the MS-III full-rate production decision often has changes incorporated as a result of the IOT&E experience.

PART IX

LIVE FIRE TEST AND

AND EVALUATION (LFT&E)

LIVE FIRE OVERVIEW

The Live Fire Test and Evaluation (LFT&E) Program was enacted into law by Congress in FY86. From its inception, the program has required realistic survivability and lethality testing on platforms and weapons to assure that our major systems perform as expected and that our combat forces are protected. The law has proven both enduring and flexible, and permits test realism to be balanced against cost and practicality.

Fiscal Year 2000 marked the sixth year since the Federal Acquisition Streamlining Act mandated that the LFT&E Program should become an integral part of the DOT&E mission. The integration of the LFT&E Program into the DOT&E mission has enabled DOT&E to take a more balanced look at weapon system effectiveness, suitability, and survivability. LFT&E is primarily driven by the physics of failure mechanisms, and often requires destructive testing under conditions not possible in OT&E. Conversely, OT&E provides LFT&E with insights into the operational conditions under which LFT&E results should be evaluated.

LFT&E addresses both the survivability of our platforms (e.g. armored vehicles, aircraft, ships, and their crews) and the lethality of our weapons systems (e.g. munitions and missiles). Fiscal Year 2000 saw the number of programs under DOT&E LFT&E oversight at an all-time high, rising to well over 80 programs by the end of FY00. These programs are nearly evenly divided between weapons platforms assessing their survivability (fixed and rotary wing aircraft, ships, and land combat vehicles) and weapons assessing their lethality (strategic and tactical missile systems, precision weapons, bombs, torpedoes, and projectiles, etc.). In fact, this year alone, a total of ten systems completed their LFT&E programs and sent their reports to Congress, more than in any year in the 14-year history of the program.

LFT&E supports the warfighter. The question asked without exception by every warfighter is, "Will my weapons platform take a hit from the threat and still allow me to complete my mission and get home?" It does not matter if the platform is a tank, fighter, bomber, ground or air troop transport, helicopter, submarine, frigate, or aircraft carrier; the question is still the same. The concern is, "Is my platform survivable in combat?" The purpose of Live Fire is to reduce the risk of casualties and concern in the minds of all Commanders as they enter harm's way. The U.S. Congress addressed these concerns when they enacted Section 2366, Title 10, U.S. Code, *"Major systems and munitions programs; survivability testing and lethality testing required before full scale production."*

Platform survivability must be built into each weapon system as early as possible in the acquisition process. It begins at the component-level initial design stage and extends throughout the entire system design development process, from sub-systems to assemblies, to systems, to full systems and finally to full-up, system-level. At the full-up, system-level, the weapon system is fully configured for combat with all sub-systems operational and powered on.

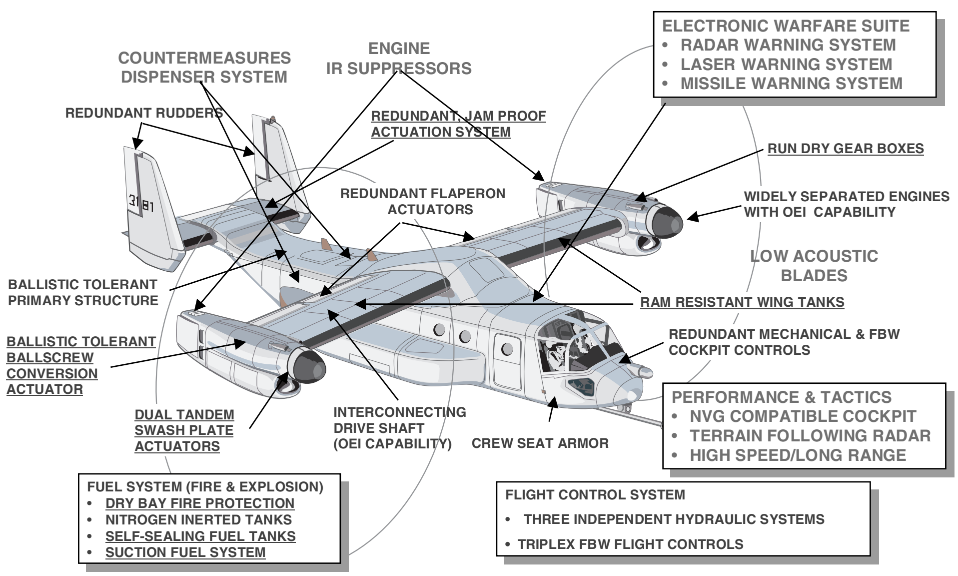
REAL LIFE EXAMPLES OF LIVE FIRE IN ACTION

Occasionally, the question gets raised as to what the value added of testing really is. In recent years, there have been a number of specific examples that demonstrate major positive impact, not only in making system designs more survivable and lethal but also by providing benefits in tactics, doctrine, and even battle damage repair procedures. I would like to illustrate with two current examples, the V-22 Osprey tilt-rotor aircraft and the DDG 51 AEGIS Class ship.

V-22 LFT&E

The V-22 was conceived as a combat assault aircraft designed to address the issue of rapid ship-to-shore movement and embassy rescue missions. The program started component-level vulnerability testing in 1984, prior to the passage of the 1986 Live Fire law, at which time it was placed on Live Fire Test (LFT) oversight. The V-22 employed the revolutionary design concept of a composite aircraft capable of converting between level flight and hover modes. Because of this new design concept, we encountered many new vulnerability questions. To address these questions, a series of Live Fire tests were conducted at the China Lake Naval Weapons Station's Survivability Laboratory. As design improvements were identified by these Live Fire tests, the weapons platform components were re-designed to allow for continued weapon system performance even if degraded from a threat impact.

THE V-22 SURVIVABILITY BALANCE
"SUSCEPTIBILITY & VULNERABILITY" REDUCTION
DESIGN FEATURES



The diagram of the V-22 depicts some of the specific design changes that reduce V-22 susceptibility and vulnerability. These changes resulted in reducing both susceptibility to being hit (in orange) and reducing the V-22's vulnerability when hit (in blue) by an expected threat system. The changes made hits to the rotor blades more survivable (approximately 1/3 of the total presented area of the aircraft), added several automatic fire suppression systems in case of hits in the fuel cells, added separation and redundancy to critical hydraulics systems, and provided special gear boxes that continue to function a full 30 minutes after losing their lubrication. The entire V-22 LFT&E program was completed at a cost of less than ¼ of 1 percent of the total cost of the program. Furthermore, the pre-test predictions required prior to every Live Fire Test, served to help calibrate the aircraft Modeling and Simulation (M&S) capabilities of the DoD. This is certainly a good news story.

DDG 51 FLIGHT I AEGIS LFT&E

Some have asked, "How can you do a live fire test program on a billion dollar ship? The answer is "carefully," but you must nonetheless do it. This leads me to the DDG 51 AEGIS Class Ship, another example of how LFT&E can and has had a very positive impact on platform design and crew training.

The ship was first identified as an LFT&E oversight program in 1987, shortly after LFT legislation was passed. We recognized early on that firing at the entire ship, combat-loaded, was going to be unreasonably expensive and impractical. Hence, we worked with the Navy to put together a Live Fire Test program, which would result in a building-block approach starting early in the program, and gradually progress to the testing of the entire ship at levels that would not cause loss of the ship and its crew.

The LFT&E plan called for a series of vulnerability assessment reports to be made, then component/sub-system testing of various ship components and equipment, and modeling and simulation followed by realistic testing for penetration, shock and fire propagation, and suppression. Sub-scale models were also built and tested; a multi-floor hull section was built on land and tested for survivability to shock and blast. A foreign surrogate ship was even re-configured and tested (and eventually purposely sunk) to gather additional insights into the ship's vulnerability.

Flight I consisted of ships DDG 51 through DDG 71. Later in the LFT&E program, one of the ships in the DDG 51 class, DDG 53 (USS JOHN PAUL JONES), was taken to sea to conduct realistic underwater Full Ship Shock Tests (FSST) against the entire ship with its crew aboard and equipment functioning. Out of these tests came over 100 design and procedural changes due to the unexpected failure of certain systems to withstand the tests. Since crew were on board, the intensity of the blast had to be below levels at which the ship hull would be expected to fail.

One would ultimately have to ask, "How do you eventually test the ship's vulnerability to actual expected threat levels?" The answer is to couple all of the data learned in earlier LFT&E testing into a series of live fire events called Total Ship Survivability Tests or TSST. The Navy conducted TSST on the DDG 58 (USS LABOON). The ideas for these tests were born out of the LFT&E program office several years ago, and have now become an integral part of the way ship LFT&E is done. An AEGIS-class ship, complete with crew, went to sea with the understanding that they would experience a series of simulated attacks from various potential threat weapons. With little to no warning, the ship's leadership would sound an alarm indicating to the crew that they had just been "attacked" by a given threat. The ship's leadership would then immediately degrade the ship by cutting off power, fire protection, hydraulics, computers, doors, stairwells, simulate fire and smoke etc., based on what might occur given an actual attack, and learn how to fight and save the ship.

The Navy identified over 120 lessons learned from these trials performed under the DDG 51 Flight I LFT&E program, and used the knowledge gained to improve the ship's design and develop improved methods and procedures for combating damage. An automated battle damage display panel was developed to quickly identify and locate damaged systems and allow bridge personnel to take corrective action without loss of valuable time. A set of realistic training scenarios are being used to prepare DDG 51 crews for events such as those recently experienced by the USS COLE, another ship of this class. In fact, this recent tragic attack would most likely have been much more severe had the numerous survivability design improvements and tactics lessons learned in LFT&E not been applied.

LFT&E continues in DDG 51 Flight II/IIA beginning with DDG 73. TSST on DDG 79 (USS OSCAR AUSTIN) and FSST on DDG 81 (USS WINSTON S. CHURCHILL) are scheduled to occur in FY01. Modeling and simulation is also part of the LFT&E program, and will compliment FSST and TSST.

The V-22 and DDG 51 programs took advantage of opportunities afforded by their LFT&E programs. Knowledge gained from their respective Live Fire Test programs was used to make design changes that resulted in reduced system vulnerability and increased system survivability, changes that will certainly save lives and our combat systems.

These programs initiated contact with LFT&E early on in their programs. The Navy, in particular, decided to include susceptibility and vulnerability from the outset in its DDG 51 LFT&E program. They actively used the LFT&E program to gain valuable knowledge and insight, which was used to improve the ship design and develop enhanced battle damage control and repair methods. This exemplifies the goal of the Live Fire Test program.

The Live Fire Test Office conducts a multi-faceted program comprised of many coordinated efforts that have and continue to actively: (1) improve the survivability of fielded U.S. weapon systems, as well as those weapon systems undergoing acquisition; (2) reduce the vulnerability of fielded U.S. weapon systems as well as those weapon systems currently undergoing acquisition; and (3) increase the lethality of U.S. weapons. This includes survivability in both combat and peacetime environments. Crew casualty reduction is a major ongoing part in the Live Fire Test program. Specific accomplishments completed during the past year are presented in the following sections.

SPECIAL PROJECTS/INITIATIVES

MODELING AND SIMULATION FOCUS AREAS

The Secretary's theme to make more effective use of modeling and simulation opportunities is the guidance under which the LFT&E program has developed a modeling and simulation advocacy program. The LFT&E program supports the responsible use of modeling and simulation in several ways, ranging from the immediate application of models to acquisition programs, to mid-term and long-term model development initiatives. These include:

- **LFT&E PRE-TEST MODEL PREDICTIONS:** Requiring pre-shot predictions for every Live Fire and Joint Live Fire Program has added discipline to the T&E process. Comparing model predictions to test outcomes continues to provide valuable data to validate or improve our vulnerability/lethality models.

- **TILV PROGRAM:** A Target Interaction Lethality Vulnerability (TILV) program has been established to bring together technical experts from the military services and the Defense Threat Reduction Agency, to assure that their research addresses gaps in vulnerability and lethality technology without duplicating efforts. The TILV group is co-chaired by Deputy Director, Defense Research and Engineering (DDR&E) and the Deputy Director, Operational Test and Evaluation for Live Fire Test (DDOT&E/LFT), and is intended to help prioritize mid-term model development investments.

  The TILV Master Plan and Investment Strategy is a comprehensive effort to identify the technology investment areas providing the largest payoff to the Lethality/Vulnerability (L/V) community. This activity provides a forum for L/V experts from across the Services, and other DoD elements, to identify and prioritize areas where technology advances are needed in M&S. Service updates have been incorporated, and a revised plan will be available to support the Technology Area Review and Assessment process.

- **MEMORANDUM OF UNDERSTANDING (MOU) WITH THE DEPARTMENT OF ENERGY (DOE) ON M&S:** Long-term model improvements are the objective of initiatives established with the Department of Energy National Laboratories to utilize and evaluate physics-based computer models. Since the LFT&E program is "Test Data Rich" and DOE's Labs are "Model Rich," this effort has been mutually beneficial. These models have the potential to improve the understanding of system-level behavior by more accurately modeling fundamental component and material behavior. Through an agreement between the Director, OT&E, and the Assistant Secretary of Energy for Defense Programs, advanced computer codes of the Accelerated Strategic Computing Initiative are being used to help make pre-shot predictions for a wide variety of Live Fire Test and Joint Live Fire test opportunities. This effort has proven to be mutually beneficial for both organizations, and continues to grow in importance.

- **M&S SURVEY OF ACQUISITION PROGRAMS:** Recognizing the growing role that M&S is having in the T&E and acquisition activities of DoD, with the policy of the Department being one of simulation-based acquisition, we felt that it was important to understand how programs were being made: by whom, to whom, which models, and who pays for them/who owns them. IN FY99 DOT&E initiated, with the cooperation of the

Defense Modeling and Simulation Office and the Service Acquisition Executives, a Modeling and Simulation Survey to help answer these and other questions relative to M&S investments.

Twenty-two programs, including air, land, and sea platforms; weapons; and Command, Control Communications and Intelligence systems, from ACAT I-ACAT IV, were included in the study. The purpose of this study was to profile the investment in M&S software supporting Program Managers. This survey was completed during FY00 and extensively briefed to the DoD Pentagon leadership, including OSD and all Service Acquisition Executives. This has resulted in several specific changes relating to M&S to be included in acquisition policy.

- **MODELING AND SIMULATION PILOT PROJECT:** (As a follow-on to the Modeling and Simulation Survey discussed above.) In FY00 DOT&E initiated an M&S pilot project with each of the three Services. Each Service selected a candidate acquisition program for the pilot project. The purpose of this project is to develop an M&S methodology that more efficiently and effectively guides the use of M&S to support acquisition.

- **SAFETY AND SURVIVABILITY OF AIRCRAFT:** The Safety and Survivability of Aircraft Initiative (SSAI), now in its fourth year, is a collaborative M&S/Test effort between DOT&E/LFT&E, Sandia National Laboratories, and the Air Force Research Laboratory (formerly Wright Labs). The objective of SSAI is to critically assess our ability to predict the safety of aircraft in fire and blast events under flight conditions. The approach selected involves the use of computational models, well-instrumented experiments, and live fire tests. The complexity of fire scenarios and the requirement to address many different operational scenarios required a tiered modeling approach. This effort has shown that complex phenomena like fire cannot be properly understood by testing or modeling alone. The reconciliation of careful observations with detailed models does, however, provide an unprecedented capability to look inside the complexities of the fire environment. Opportunities to continue this work and extend it to the safety and survivability of ships and ground vehicles are being investigated.

- **OTHER M&S INITIATIVES:** Estimates of on-ground effects from chemical and biological agents released in a strategic or tactical missile intercept are the subjects of an LFT&E study concluded during FY00. There are many sources of uncertainty in the processes associated with missile intercept damage, agent dispersal and agent cloud formation, transport of that agent to the ground through complex weather and atmospheric conditions, and the subsequent impact on protected assets.

We are addressing the portions of the M&S spectrum that have the most significant impact on a particular problem of interest. We are working with the Defense Modeling and Simulation Office to help identify areas within the Conceptual Models of the Mission Space that are particularly important for relating data from Live Fire tests to assessments of compromised mission utility.

IMPROVEMENTS TO THE DoD 5000 SERIES

Fiscal Year 2000 saw the culmination of efforts initiated by DOT&E in July 1998. At that time, DOT&E proposed a forum to clarify LFT&E policy within DoD. Together with Army, Navy, and Air Force Test & Evaluation executives, we drafted new regulations consistent with Live Fire Test legislation, and reached consensus in late 1998. In 2000, these changes were incorporated into DoD

Regulation (DoD 5000.2-R). The changes: (1) clarify existing DOT&E policy requiring M&S predictions prior to Live Fire tests; (2) require evaluation of U.S. platform vulnerability to validated directed energy weapon threats; and (3) define LFT&E procedures and requirements for programs lacking a defined EMD or B-LRIP milestone.

LFT&E INTERNATIONAL MOU AGREEMENTS

Recognizing the importance of formal international cooperation and collaboration, this year the Live Fire Office initiated the development of a bi-lateral Memorandum of Understanding with several U.S. allied nations. The Live Fire Test Office is currently working on the development of these MOUs.

LIVE FIRE TESTING AND TRAINING (LFT&T) PROGRAM

The LFT&T Program directly supports another of the Secretary's T&E themes, that of bringing together the testing and training communities for their mutual benefit. It fosters the exchange of technology development initiatives and uses between the live fire test and training communities to better serve the ultimate customer—the warfighter. For the first time, the FY97 Defense Appropriation included funding to investigate alternative uses of simulation and training technology in support of Live Fire Testing and Evaluation. This initiative came to be known as the Live Fire Testing and Training program. Another goal of the program involves establishing partnerships between DoD and the civilian sector.

Congress has demonstrated growing support for this program each successive year since its inception, with funding for FY00 at its highest level yet. The LFT&T Program was initiated with $3 million in FY97, and continued with $4 million in FY98, followed by $5 million in FY99, and $7 million in FY00. Fiscal Year 2001 funding support for this initiative is larger yet. We have taken steps to fund this initiative through the LFT&E Program Element.

This program draws heavily on major U.S. simulation and training center expertise and is administered jointly by DOT&E along with the Services' simulation and training agencies. The program is managed by the LFT&T Senior Advisory Group (SAG), comprised of the commanders of the four Service training and simulation commands (STRICOM, NAWCTD, AFAMS, etc.) and chaired by DDOT&E/LFT.

The SAG meets several times per budget cycle to review proposals coming in from both government and industry, to select those most promising and oversee their progress and products, assuring that these efforts focus on readiness and also meet the needs of the testing and training communities. Several projects have "graduated" from the LFT&T program, and are already providing benefits to the warfighter.

The following projects were initiated under the LFT&T program and transitioned in FY00 to a follow-on user or sponsor:

- **COMBAT TRAUMA PATIENT SIMULATION:** This program leveraged existing commercial-off-the-shelf and government equipment to develop an integrated military medical simulation system for test and evaluation and training of medical personnel. The Combat Trauma Patient Simulation (CTPS) system provides the capability of simulating, replicating, and assessing battlefield injuries by type and category, monitoring the movement of casualties on the battlefield, capturing the time of patient diagnosis and treatment, and comparing interventions and outcomes at each military health care service delivery level. The CTPS system supports user assessments from field level to hospital trauma level. The CTPS program is a great success, receiving endorsements from the U.S. Army Surgeon General, the U.S. Air Force Surgeon General, the U.S. Army Medical Research Materiel Command, the National Guard Bureau, and the Special Operations Command. The National Guard is currently using CTPS to train first responders at Ft. Indiantown Gap, PA. The development of this system is continuing beyond the LFT&T Program. Congress provided additional funds in FY00 to expand the development of the system through FY01. The CTPS program brings live and virtual simulation to the medical training community, resulting in increased readiness of military medical personnel, and draws upon the user casualty prediction made from LFT&E.

- **SYNTHETIC ENVIRONMENT LIVE FIRE:** The objective of this project is to use a synthetic environment and simulation in a live fire test and training event to reduce the risk of test design flaws by allowing the test event to be conducted in the synthetic environment before actual physical execution, and to train both crew and individuals prior to actual live fire. The Bradley Fighting Vehicle was used as the candidate demonstrator. The Synthetic Environment Live Fire (SELF) project augmented existing test methodologies by replicating LFT&T in the synthetic environment. The SELF tests have clearly demonstrated that a high-fidelity training device is a capable test tool. Data are more easily accessed, thus providing a more flexible test infrastructure. Test officers using the SELF test have found the infrastructure useful for test preparation and design, pre-test exercises, and detailed data acquisition. Recently, the Army Program Manager for Combat Identification completed his Battlefield Combat Identification System (BCIS) IOT&E using test data obtained by testing the capabilities of the BCIS-equipped vehicles in this Close Combat Tactical Trainer (CCTT) device at Ft. Hood, TX. This entire test was conducted in a modeling and simulation environment on a CCTT system previously thought to be solely a training device, now a test and training device.

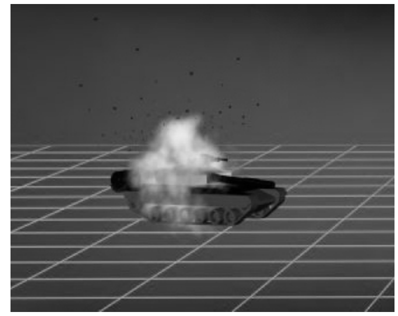
- **VULNERABILITY/LETHALITY SIMULATION ENHANCEMENTS:** This project focused on developing a methodology for improving damage assessments in tank-on-tank gunnery simulations used in the training, test, and analysis communities. The Probability of Kill (P_k)

methodology currently employed in these simulations does not provide for a detailed assessment of likely damage and resulting loss-of-function capability in simulated engagements. The goal of Vulnerability Lethality Simulation Enhancements (VLSE) was to find a way to replace the P_k methodology that would be acceptable in both communities and demonstrate the approach in one or more training system applications. The result has been development of a Degraded States Vulnerability Methodology (DSVM). The concept for DSVM was demonstrated with two current tank gunnery training simulations. Additional work accomplished under this project involved developing a methodology for new approaches to behavioral modeling of computer-generated forces—an important step for successful application of the degraded states methodology. The primary objective has been significant qualitative improvements in training and analysis of simulations so that we can avoid negative training (i.e., "train as we fight") and better evaluate system designs and tactics. The VLSE Project has directly resulted in a new initiative within the Army test/analysis community to further develop this methodology and expand its applications. The initial VLSE Project provided a platform and testbed for the Army Materiel Systems Analysis Agency's continued degraded states development efforts, and also supports the next generation of computer-generated forces (OneSAF) and other simulation developments.

The following projects are currently underway, comprising the FY00 LFT&T Program:

- **EFFECTIVENESS OF SMALL ARMS FIRE:** This project provides a re-configurable engineering tool, the Small Arms Simulator Testbed (SAST), for the small arms testing community which uses visual and physical modeling and simulation techniques to design, test, evaluate, and modify new small arms weapon concepts. Initiated as a project to support concept development and evaluation of the U.S. Army's Objective Individual Combat Weapon (OICW), the SAST has evolved into a tool that identifies critical technical/engineering issues through metrics associated with live fire test of future small arms. SAST also shows marked potential as a training aid of existing weapons. The testbed has resulted in more informed acquisition decisions by providing vital lethality metrics into small arms system design, thereby reducing the prototype development cycle time. Developmental issues such as error budgets, fire control systems, laser range finders, aiming, recoil effects, ballistics, probability of incapacitation, and weapon ergonomics are typical issues that can be examined by the SAST device. The SAST system has provided simulated live fire test data to the Army Research Laboratory and the Army Armament Research and Development Center to support development and testing for the OICW and the Force 21 Land Warrior Program. Efforts have yielded more than $10 million in direct savings to design and evaluation efforts. This project has the potential to greatly enhance the realism of anti-terrorism training simulation in urban settings for current and future weapon systems.

- **SIMULATION FOR PRODUCING REALISTIC MUNITIONS IMPACT FLASH EVENTS:** This project is exploiting live firings of anti-armor munitions against armor targets to collect impact signatures at various wavelengths to be used to guide development of synthetic image generation for use in trainers. These modeled results will be integrated into training simulator visual systems, providing gunners with an indication of what to expect from the impact flash effects resulting from engaging real targets, rather than the artificial image signatures now employed.



- **THREAT WARHEADS AND EFFECTS/BATTLE DAMAGE ASSESSMENT AND REPAIR (BDAR):** This is a joint U.S. Army and U.S. Air Force effort to develop a portable computer-based Battle Damage Assessment and Repair data storage/retrieval and training system supporting assessment and repair of battle damaged ground vehicles and aircraft. In support of Joint Live Fire (JLF) and Live Fire Test (LFT), BDAR engineers and technicians have been used to assess and repair test articles. Those technicians making the repairs, who are the actual military personnel that will be called upon to do repairs in combat, get exposure to realistic threat effects and damage on current and emerging vehicles, and quality hands-on experience. Though many of the BDAR technicians and engineers try to capture what they have learned and pass it on to their units, the information is often limited to a specific LFT program and distributed to the single PM restricting the potential training value. The problem was that no method existed to provide effective BDAR proficiency and threat warhead effects training, which provides realistic problem situations on current and emerging weapon systems, and constructive feedback. The objective of this project is to provide an efficient and effective method to capture, distribute, and use JLF and LFT information to enhance the proficiency of the combat maintainers and operators through realistic training across the board.

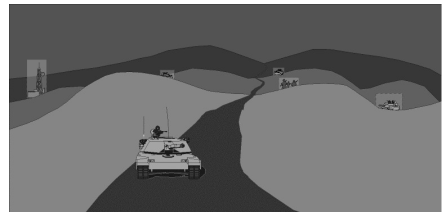
- **AUGMENTED REALITY-BASED FIRE FIGHTING FOR TOTAL SHIP SURVIVABILITY:** This is a proof-of-concept project supporting Total Ship Survivability Tests using Augmented Reality (AR) technologies to demonstrate the role of shipboard firefighters in fire damage assessment and fire extinguishing exercises. The objective of this project is to assess the feasibility of using current and future AR-based technologies in shipboard testing and training environments. Specifically, investigations into, and demonstrations of various display and tracking technologies, have been evaluated to demonstrate the capability to overlay realistic-looking fire, smoke, and extinguishing virtual images onto the real-world ship environment, including facilities, equipment, and other personnel. Augmented Reality promises to provide numerous benefits to the testing and training communities including improved realism, reduced operational

costs, dramatic safety improvements, elimination of combustion by-products, and elimination of environmental concerns.

- **DISMOUNTED INFANTRYMAN SURVIVABILITY AND LETHALITY TESTBED:** The Dismounted Infantryman Survivability and Lethality Testbed (DISALT) project leverages the existing high-fidelity SAST technology while developing and implementing new technology to provide a common framework to examine the complex interrelationships between man and multiple weapon systems. The specific objective of the DISALT system is to provide a validated multi-user small arms trainer infrastructure, allowing live fire testing and training communities to analyze, and subsequently optimize, the lethality and survivability of a fighting team. The DISALT system would further allow the small arms communities to more fully analyze and understand the synergistic effects of multiple weapon systems in a virtual collective exercise environment. In turn, the data collected during DISALT exercises would directly address the lethality and survivability of a team of soldiers, taking into account the synergy of multiple soldiers and weapon systems. This would ultimately lead to conclusions regarding optimization of weapon systems, tactics, mission effectiveness, and optimal training methods. In addition, performance metrics and methods of analysis would be developed to provide data reduction supporting the LFT&E and training communities.

- **ENHANCED RECOVERY OF AIRCREW FROM ACCELERATION-INDUCED LOSS OF CONSCIOUSNESS/ENHANCED ACCELERATION TRAINING:** One of the primary sources of loss of military high-performance aircraft and their crews results from their high-maneuverability. Acceleration, or gravitational-induced loss of consciousness (G-LOC) is one, if not the main, physiological threat to aircrew of high-performance aircraft. The objective of this task is to test several technologies that may be able to reduce the period of incapacitation occurring after a pilot experiences G-LOC. Investigation of these approaches holds the promise of discovering practical, simple, and cost-effective countermeasures capable of greatly reducing the mishap rate due to loss of consciousness in aircraft during peacetime, training, and combat situations. The first task under this project was to identify acceleration-induced aircrew issues in Navy and Air Force tactical aircraft. Additional tasks use Air Force centrifuges to test the efficacy of specific technological approaches to enhance recovery, including introduction of various physical stimuli including auditory, tactile, olfactory and visual sources, previous G-LOC training experiences, deflation rate of anti- G-suit, and reduced recovery acceleration levels. Reduction in the period of incapacitation will reduce the instances of aircraft and/or aircrew mishaps/losses due to G-LOC, enable the pilot to utilize the aircraft to its maximum performance potential, improve the mission and/or training experience, and enhance the overall utilization of the nation’s warfighters and their aircraft.

- **INFRARED TARGETS TESTING AND TRAINING:** Training in the use of Infrared (IR) sensors requires targets that closely mimic the appearance of real targets in the IR spectrum. Approaches have been developed involving heated surfaces, but these are costly and sometimes not realistic. Initial explorations have proven a basic design for an IR projector based on Digital Light Processor (DLP) video projectors. The Infrared Targets For Testing and Training (IRT^3) project will adapt this technology to the live fire test and training arena. The IRT^3 project will develop an IR projection capability suitable for providing live fire targets for testing and training with IR systems in the 8-12 micron band. Under computer control, the projected images could appear and disappear, realistically simulating actual targets. The DLP technology will produce the full range of military targets on re-usable and re-newable (water based) projection screens. The use of projection technology will permit the isolation and protection of the expensive projector, only exposing a relatively inexpensive projection media to destructive fire. The projection media will be less costly than current targets, so the result will be improved realism and cost savings.



- **EXPLOITING LFT DATA TO IMPROVE WARFIGHTER SITUATIONAL AWARENESS IN COMBAT AND TRAINING:** Attack aircraft try to achieve first-pass attack success to increase mission survivability, while minimizing fratricide and collateral damage. Pilots and weapons systems officers need good situational awareness to make accurate and confident time-critical decisions. In training, this technology will familiarize pilots and weapons systems officers with the capabilities and effects of various weapons in a variety of attack scenarios. The technology will be designed for a specific host aircraft, but will be applicable to the aircraft of all three Services.

- **MISSILE WARNING SENSOR SIMULATOR:** The battlefield proliferation of light vehicle and man-portable air defense missiles is driving the development and deployment of a number of electro-optical missile warning receivers and associated countermeasures (flares, chaff, EW, etc.). The development of the Missile Warning Sensor Simulator (MWSS) was initiated to demonstrate that open-air testing of missile warning systems is possible without the expense of live firing large numbers of threat missiles. The objective of this project is to evaluate and enhance the capabilities of the MWSS and conduct a comprehensive verification and validation program. The MWSS is a transportable test and training tool designed to support operational evaluations of the AN/AAR-47 missile warning system that can be conducted with fully operational crews and aircraft performing realistic maneuvers and tactics. Earlier results from these tests have shown that the concept of an ultra violet laser stimulator is not only feasible, but also that the stimulator can highlight tactical considerations where the AN/AAR-47 is combined with other defensive systems to counter, defeat and/or destroy

infrared threat missiles. The enhanced MWSS will be a one-of-a-kind system, filling a void in infrared threat training, tactics development, and missile warning system testing, and will provide an improved means to assess aircraft survivability against infrared seeker missile threats. It will be deployable to most test ranges, can be operated in a safe manner with an ultra violet laser that is eye-safe at 13 meters, and will provide data at low cost with its two-person operation and capability to produce several tens of shots per hour—limited only by the operation of the aircraft against which it is deployed. With the completion of its development, the MWSS will be a flexible open-air testing, training, tactics development and evaluation tool that will have application for all the Services' aircraft employing missile warning systems.

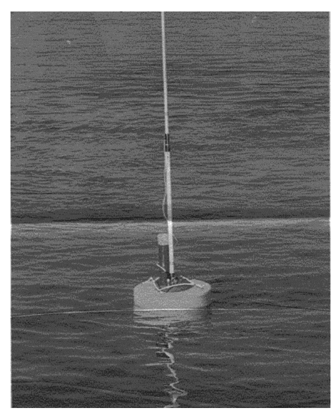
- **VIRTUAL ENVIRONMENT SIMULATION FOR SHIPBOARD INCIDENT MANAGEMENT:** There is a requirement for both medical and non-medical personnel in the Navy to be trained and exercised in first response to major incidents involving damage to ship structures, systems, and personnel. Although ship interior spaces and systems have been modeled and represented in virtual environments in varying levels of detail, these have been modeled in undamaged states. And, although models have been developed to assess ship damage and survivability as a result of specific weapons effects, we are not aware of any efforts to accurately represent such damage in a virtual environment. This project will use ship design, off-the-shelf software, and the Virtual Environment Technology Testbed to develop a prototype shipboard virtual environment to train "first responders" in management of major casualty incidents. Similarly, by incorporating realistic damage modeling and representation, this project can serve as a platform for testing concepts in ship design for evaluating vulnerability, survivability, and recoverability.

- **DEVELOPMENT AND IMPLEMENTATION OF NEW STANDARD VULNERABILITY/LETHALITY METRICS FOR FUTURE SIMULATIONS:** The objective of this project is to provide a sound methodology and set of vulnerability/lethality metrics to enable the combat simulation analytical and training communities to more accurately represent and analyze various aspects of combat capability. A set of test conditions will be modeled in several combat scenarios to examine the complex relationships between vulnerability fidelity (e.g. incorporation details of various loss of functions) and force effectiveness. In addition, new measures of effectiveness may be developed to provide a more accurate representation of battle outcomes. The proposed vulnerability metrics will substantially increase the fidelity and realism of vulnerability/lethality in simulations and have a cascading effect to many other areas, such as systems performance, human behavior representation, tactics, and force structure development. The proposed vulnerability metrics will provide mathematically accurate standard methodology to simulation developers from the analytical and training community to allow for high-fidelity modeling of vulnerability. Analytical studies involving performance issues, such as vulnerability reduction, weapon effectiveness, and logistics will directly benefit from improved vulnerability metrics. Higher fidelity

vulnerability modeling results in more representative visual and damage effects. Also, the analytical community will be able to better analyze and understand the synergistic effects of multiple impacts and the logistics support required for combat damage repair.

- **LIVE FIRE ADVANCED CONCEPTS:** Live team exercises for the dismounted soldier are complex and inherently dangerous. The Live Fire Advanced Concepts project explores the concept of how existing technologies and efforts can be leveraged to create a testbed that can be utilized for both live fire test and evaluation as well as collective and individual training. Although both a development and integration effort, this concept capitalizes on government, industry, and university investments. This project incorporates proven technologies to create a virtual world that simulates the dismounted soldier battlespace. This virtual world will be created by the utilization of the RealGuy™ system, which allows the soldier to maneuver throughout the battlefield utilizing a head-mounted display to view the terrain and both friendly and opposing forces. A model of a future weapon, such as the Objective Individual Combat Weapon, will be integrated into this virtual world, allowing the soldier to train, test, and develop new tactics, techniques and procedures. As the soldier traverses his area of operations, realism will be enhanced with the incorporation of 3-D audio and olfactory effects. This provides a suite of input (sight, sound, and smell) to the soldier to stimulate the human decision making process. Critical events and decisions will be recorded to facilitate the after-action review process and collect data on the lethality, survivability, and vulnerability of the weapon under evaluation.

- **VIRTUAL TARGET AND RANGE SYSTEM:** The Virtual Target and Range (VITAR) system is a portable, acoustic impact scoring system that is light-weight, compact, easily stored aboard ship, and deployed at suitable locations throughout the world's oceans. This project will initially provide a prototype system for conducting cost-effective live surface fire support exercises and supplementary training to Navy units. The final system will have the capability to determine the position of an impact and transmit the data back over-the-horizon to a system controller. The shipboard system controller will accurately display the impacts on real maps over any virtual terrain or target. The controller will have the capability to operate as a stand-alone system, or interfaced with shipboard systems to provide real-time feedback to the crew. While the VITAR system will not replace fixed ranges, it will allow individual ships to fire and score a wide selection of live fire training exercises almost anywhere at anytime. Ships being sent to combat areas can perform live fire tests of their guns to ensure their accuracy and operational effectiveness near their homeport. In addition, Long Range Weapon Systems such as the Advanced Gun System, the Extended Range Guided Munitions, and the Barrage round may not be tested to their full range capability due to test range limitations. The VITAR system will also allow full range testing at sea.



Live Fire Testing is unique in that, apart from actual combat, it is the only source of realistic combat vulnerability and lethality data, battle damage repair procedures, and estimates of user casualties.

This program takes this realistic data and combines it with training technologies and opportunities in a synergistic way. Efforts continue to make this program a funded part of the LFT&E Program Element.

REPLACEMENT OF HALONS AND OTHER OZONE-DEPLETING SUBSTANCES

Fire is, by far, the major source of U.S. combat casualties. Hence, fire detection and suppression is vital in the LFT&E of any platform. Weapons platforms use an array of ozone-depleting substances as fire and explosion suppressants. However, the Montreal Protocol now bans the production of these substances. Section 612 of the Clean Air Act, and Presidential Directives 12843 (1993) and 13148 (2000) call for the replacement of these substances where technically and economically feasible.

- **F-16:** Currently, the most Halon-emissive platform in the DoD inventory is the F-16 Falcon. TheF-16 uses Halon 1301 as a fuel tank explosion suppressant (so called inertant). It dumps 13 pounds of Halon 1301 into the atmosphere every time it is sent into a combat/bombing mission, whether the aircraft is hit or not.

  During FY98-99, the Air Force Research Laboratory, 46th Test Wing, and the Aeronautical Systems Center performed an extensive investigation on the search for the replacement for Halon 1301 as a fuel tank inertant for the F-16 Falcon.The RDT&E effort yielded the substance CF_3I, an effective, non ozone-depleting chemical, approved by the EPA for normally unoccupied areas, that performs equally with Halon 1301 and is a virtual drop-in replacement. The technology was thoroughly vetted and transitioned to the F-16 System Program Office with the approval of the Air Force Research Laboratory and the Aeronautical Systems Center. Airframe manufacturers also endorse the use of the agent, and Lockheed Martin performed a study to evaluate the retrofit costs for this application. CF_3I offers an additional benefit in its synthesis: CF_3I can be manufactured from Halon 1301 stocks, thus negating the need for destruction of the current stock of Halon 1301.

  During FY00, CF_3I has undergone extensive testing to assure its effectiveness. The Services have also been briefed on its effectiveness.

- **OTHER PLATFORMS:** Other weapons platforms also use Halon 1301 as a fire suppressant for engine compartments, dry bays, and Auxiliary Power Units (APUs), and there is an ongoing effort within DDR&E (Next Generation Program) to find suitable replacements for these applications as well. While CF_3I could, in principle, be used in most platforms where the application can be defined to be a normally unoccupied area—such as engine nacelles, dry bays, and APUs—test and evaluation still needs to be performed to validate laboratory and preliminary tests. Good candidates for the testing and possible use of CF_3I as retrofit or forward fits include cargo and fighter planes engine nacelles, dry bays, and APUs. The F-117 is considering the use of an On-Board Inert Gas Generating System (OBIGGS) for fuel tank inertion at considerable weight and space penalties. CF_3I may be considered a viable option considering the success of the F-16 program.

  During FY00, the LFT&E office has provided information to the Comanche PEO in their RDT&E efforts to find a Halon alternative to their engine nacelle application. The LFT&E office has assembled a panel of Army, Navy, Air Force, and EPA experts to provide feedback to the PEO. As to their selection process, LFT&E staff have also reviewed and provided improvements to test plans by the Navy for their F-14 fuel tank inertion tests, and to the Army for the Chinook CH-47 engine nacelle fire tests and F-117 OBIGGS.

CREW CASUALTY ASSESSMENT

The most important component of every live fire survivability test is an assessment of crew survivability—a determination of whether the crew or individual members of the crew could have performed physical tasks, completed the mission, and/or advanced to a safe position, subsequent to experiencing an incoming threat. During FY00, three crew casualty/survivability-related initiatives were conducted, over and above the system-specific LFT programs described throughout this report.

- **COMBINED TOXIC GAS MODEL:** The Combined Toxic Gas Model (CTGM) program was initiated in FY95 and completed during FY00. If the immediate injury vectors (e.g., blast, acceleration, and flash) of an incoming threat are survived (and they often are) and, although many fires may be extinguished in milliseconds, the post-shot, post-fire crew compartment may still present a hostile environment to the crew. Intense concentrations of toxic gases, mists, vapors, and particulates may fill the air for a period of time after the event. They arise, for example, from melted plastics, foam, and nylon, charred cloth, incompletely combusted ambient gases, pyrolysed fire suppressant, and burnt propellants. Escaping from an enclosure filled with these combustion products requires maintaining physical and mental abilities for a few critical minutes. The concentration exposures under these circumstances are sometimes extremely high, but very brief, and are conditions not encountered in normal human activities. Assessment of the hazard under these circumstances, and analysis of the toxicological profile produced from these multiple gas combinations, are necessary to evaluate human survival and the effectiveness of crew protection systems.

  For six years, the LFT&E Office funded the development of an immediate incapacitation model that incorporates complex physiochemical interactions between gases and tissues, and accommodates experimental data across animal species and humans. There were five phases to the CTGM design. They include: (1) a comprehensive literature search to identify all possible predictive models; (2) development of a preliminary model from all available information; (3) design of a working model; (4) empirical test and refinement of the model; and (5) employment of scaling factors and validation of the model in live fire cases.

  The derived mathematical model is based on a simplified representation of the inhalation, exhalation, and accumulation of toxic substances. It estimates the ventilation rate, accounting for species differences, activity level, and chemically induced physical response. The CTGM calculates the probability of immediate incapacitation as a function of time for any combination of seven gases: carbon monoxide, hydrogen cyanide, nitrogen dioxide, hydrogen chloride, acrolein, reduced oxygen, and carbon dioxide.

  The most notable report of this now completed effort is the discovery that the toxicity of a single gas is temporarily amplified when other toxic gases are also present. Hence, the toxicity models used up to FY00 must be significantly modified to reflect these findings.

- **GRAVITATIONAL LOSS OF CONSCIOUSNESS.** The second crew casualty related initiative, conducted in FY00, was to assess the G-LOC problem. Regardless of preventive measures taken to date, G-LOC remains a persistent and serious hazard in high-performance aircraft. From 1983-1996, the Air Force (the Service with the longest history of reporting G-LOC occurrences) experienced 24 class A mishaps and 18 fatalities as a result of G-LOC.

Anonymous surveys of combat pilots also report approximately 12 percent of Air Force and Navy pilots admit having experienced at least one G-LOC episode. Because temporary amnesia follows approximately 50 percent of G-LOC incidents, and, if not, victims may be reluctant to report it (even anonymously), the actual incidence of G-LOC is probably much higher than officially reported. Informal reports suggest that a majority of fighter aircrew (60-70 percent) have experienced some degree of serious G-induced incapacitation during their careers, an estimate consistent with the pervasiveness of the hazard, and a mind-set that accepts G-LOC as one of the many inherent risks in aviation.

- **AUTOMATIC GROUND COLLISION AVOIDANCE SYSTEM:** The third crew casualty related endeavor was initiated in FY99, and continued in FY00, and is being performed to also address the G-LOC problem. The effort is piggybacking on the automatic Ground Collision Avoidance System (GCAS) developed collaboratively for the F-16 and JAS39 aircraft by the U.S. and Swedish Air Forces respectively. This system continuously predicts the aircraft trajectory 10-15 seconds into the future. A digital terrain system data base is continually scanned around and in front of the aircraft, and the pilot selects a pre-set clearance plain over the terrain. If the future aircraft trajectory should penetrate the selected clearance plain, the automatic GCAS determines the appropriate time to initiate an automatic fly-up. If the pilot does not correct the trajectory, at five seconds prior to fly-up, a warning on the pilot's head-up display will appear. If the pilot still does not correct the aircraft trajectory, at zero seconds, an automatic roll to wings level five G fly-up recovery will occur. (The automatic recovery continues until the projected flight path clears the terrain feature of concern.)

Two demonstrations have been conducted so far to investigate the applicability of the automatic GCAS to the G-LOC problem. Three sorties replicating actual fatal G-LOC instances were successfully flown in FY00 utilizing the automatic GCAS incorporated within an F-16 aircraft.

JOINT LIVE FIRE PROGRAM

The JLF program was chartered by OSD in March 1984 to conduct Live Fire Testing of fielded U.S. and foreign air and ground weapons platforms and munitions. Programs selected under the original charter, and tested, include the AV-8B, AH-64, UH-60, F-16, F-15, F/A-18, MIG-23, MI-24 (HIND), T-62, M60A3, T-72, M1, M2/M3, and BMP vehicles. The aircraft systems tested under the JLF program (known as the JLF Air Systems Program) are managed by the Joint Technical Coordinating Group on Aircraft Survivability (JTCG/AS). Likewise, the JLF Ground Systems Program is managed by the Joint Technical Coordinating Group for Munitions Effectiveness (JTCG/ME).

In the FY00 JLF Air Systems Program, vulnerability tests were conducted on the F-14 Tomcat, F-16 Fighting Falcon, CH-47D Chinook, and C-130E/H Hercules to gain insights into the vulnerability of fielded aircraft to threat munitions. Also during FY00, the JLF program conducted comparative tests of various fuel tank technologies that have been proposed for prevention of ullage fires and explosions exemplified in the TWA 800 accident. In addition, detailed plans were prepared for the second phase of vulnerability testing of the CH-47D main rotor blades and for testing the lethality of the U.S. PGU-28 20 mm projectiles against selected classified threat targets. The JLF program addressed the following programs in FY00.

- **SCUD-B MISSILE AND LAUNCHER TESTING:** Testing was conducted in November 1999 and in May 2000 against a SCUD-B Missile and Launcher at Eglin AFB, FL. The primary objective was to evaluate the vulnerability of the SCUD-B system to various U.S. inventory munitions. A secondary objective is to collect signature data before, during, and following test events to determine if signature changes might be detected and subsequently correlated to inflicted damage. The goal of this secondary objective is the development of battle damage indicator metrics that might improve battle damage assessment techniques and accuracy.

  This marks the first in a series of U.S. munitions tests that will be conducted against an operational SCUD-B missile mounted on its launcher (in the travel mode) to gather realistic data on actual threat targets recently made available for JLF testing. The first series of tests used BLU-97 bomblets, which are sub-munitions, delivered to the target area by the Joint Standoff Weapon System. M-74 bomblets, which are delivered to the target area by the Army Tactical Missile System, were tested in a May 2000 test series. Testing is expected to continue in FY01.

- **THREAT COMBAT VEHICLE TESTING:** Test planning was initiated on a threat land combat vehicle. A detailed test plan was started in FY00 and will be completed next fiscal year. Testing is expected to begin in spring 2001, with fielded U.S. threat weapons, and will include some threat weapons in development.

- **F-14 TOMCAT TESTING:** A JLF test was conducted during FY00 to determine whether an explosion in the external fuel tank could cause damage to the aircraft. Firing against an external tank mounted on an F-14 and filled with an explosive mixture of fuel vapors. Damage from the resulting explosion was limited to the tank itself. The results of this test suggest that it may not be necessary to incorporate explosion suppression features in the external tanks of this and similar aircraft since they appear to be sufficiently rugged to contain the damage.

- **F-16 MAN-PORTABLE AIR DEFENSE SYSTEMS (MANPADS) TESTING:** The Joint Live Fire program is addressing the issue of the Man Portable Air Defense Systems threat. The MANPADS threat is growing since stand-off weapons like the FIM92A *Stinger* and the Russian SA-7B *Grail* shoulder-fired, anti-aircraft missiles are increasingly available for purchase in the Mid-East, Western Asia, and Europe. Today MANPADS are found in nearly every nation on earth. As MANPADS become more readily available to terrorist groups and criminals, the potential for attacks against high value, low risk targets, such as commercial and military aircraft, may significantly increase.

  An SA-7 man-portable air defense missile was fired at a static F-16 Fighting Falcon target with the aircraft's engine running. The test was part of a broader series of tests to assess the vulnerability of U.S. aircraft to shoulder-fired MANPADS. The missile was fired from its launcher, flew free flight, guided itself to the target, and detonated on impact. Analysts, who are developing prediction/assessment modeling and simulation capabilities for MANPADS, are evaluating the damage to the test article. Previous free-flight tests with Stinger missiles launched against F-14 targets, (reported last year) have revealed unanticipated damage and raised questions regarding the unexpected damage mechanisms and weapon target interactions associated with this type of threat. The FY00 test against the F-16 was expected to be a more survivable engagement condition, replicating F/A-18 hits experienced during

Desert Storm. An initial assessment indicates the damage was less extensive than in the F-14 tests. The damage is being analyzed and compared with candidate models that will be upgraded based on these results. This test also served to demonstrate the ability to test MANPADS more realistically against aircraft with engines running.

Efforts to develop the rail-launch technique for foreign MANPADS also continued during FY00. The rail-launch technique would provide greater control over the impact location. In FY01 it is planned to duplicate the F-16 test conditions using a rail-launched SA-7. One objective of this planned test is to determine whether the rail-launch technique would affect the target damage by comparing the results with the free-flight test.

- **CH-47D TESTING:** The CH-47D Chinook JLF program addresses the planning, execution, and analysis of a series of ballistic tests to determine the vulnerability of the rotor blades and the rotor drive train system. The results of these tests will complement the ongoing LFT&E program for the CH-47F Improved Cargo Helicopter program, since the rotor blades and drive train are common to both variants. The rotor blade investigation consists of a three-phase series of ballistic tests of existing blade sections and whole rotor blades starting with static (no applied load), and progressing to quasi-static (applied static load) and dynamic (fully rotating blade system) tests. The rotor drive train test series consists of Phase 1 static component testing followed by Phase 2 dynamic testing.

  During FY00, the documentation of this JLF program was completed (Report No. JLF-TR-00-1) for the tests of the main rotor blade Phase1 static tests and the detailed planning for Phase 2. Phase 2 testing will determine the ballistic resistance of rotor blade sections under the influence of statically applied representative flight loads. The resulting damaged blades will then be structurally tested for damage growth, residual stiffness, and strength capabilities. Testing the damaged blades will require specialized facilities, and negotiations are underway with Boeing to support these tests. The rotor drive train portion of this program has been delayed due to lack of funds.

- **C-130E/H TESTING**: DOT&E designated the C-130J aircraft for LFT&E oversight in May 1995. DOT&E and the Assistant Secretary of the Air Force agreed, in March 1998, to establish a joint DOT&E/Air Force program that takes advantage of testing and evaluation under both the JLF program for the C-130E/H and the Air Force funded C-130J LFT&E program. The Air Force-funded program includes evaluation of dry bay fire, composite propeller blade vulnerability, engine and engine bay fire, and vulnerability to MANPADS. The JLF program addresses wing fuel tank vulnerability to hydrodynamic ram damage and mission abort vulnerability.

  In FY00, the JLF Program performed wing hydrodynamic ram evaluation tests on two C-130H left wing assemblies. The test series consisted of fourteen shots with several different threat projectiles fired into the wing fuel tanks at potentially critical locations. C-130 Battle Damage Assessment and Repair (BDAR) technicians from Robins AFB and a BDAR engineer were on site during the testing to assess damage and to repair the test article for subsequent shots. Detailed damage descriptions for each wing hydrodynamic ram shot were documented and sent to Lockheed Martin, the C-130 prime contractor, for analysis of post-shot residual strength and remaining flight capabilities. Results of these analyses will be published in FY01.

Planning for the C-130 mission abort vulnerability assessment under JLF will be initiated in FY01 and completed in FY02.

Several lessons learned can be drawn from this approach of leveraging JLF and LFT programs for evaluating system upgrades. For example, test articles for the aircraft upgrade LFT&E program can be economically constructed from some of the fielded models of the aircraft—if the changes are very small. For this program, realistic, production-representative test articles for LFT&E of the C-130J wing dry bay fire vulnerability were constructed from C-130H aircraft wings. In addition, the C-130H wing hydrodynamic ram damage testing conducted under JLF is applicable to both the fielded C-130 fleet and to the new C-130J aircraft. Finally, both JLF and LFT programs can benefit from active participation of on-sight BDAR personnel that quickly and economically repair test articles for subsequent shots. This approach also offers BDAR personnel the opportunity to observe realistic combat damage and receive training in assessment of damage inflicted by actual threat projectiles and application of aircraft battle damage repair techniques.

- **FUEL TANK FILLER JLF TESTS FOR FIRE/EXPLOSION MITIGATION:** The JLF Program planned and conducted two phases of a three-phase program during FY00 to evaluate six different technologies intended to protect aircraft and ground combat vehicle fuel tanks against fire and explosion when impacted by threat projectiles in the ullage, the vapor space above the fuel level. These technologies are based on various configurations of metal mesh or reticulated, open pore, foam to fill the fuel tank to prevent or suppress explosions or fires due to threat impact into the ullage. The tank filler materials are also designed to minimize fuel displacement and allow free-flow of fuel to the engine. Phase I was conducted with a heavy duty, re-usable tank wall simulator to obtain basic performance data. Phase II was conducted on an AH-1S Cobra helicopter to obtain data representative of realistic aircraft fuel tank installations. Phase III, to be completed in FY01, is planned to obtain data representative of actual ground combat vehicle fuel tank installations.

During Phase I, a 100-gallon fuel tank simulator was filled with the candidate protection technology. The tank was then filled with heated JP-8 fuel and drained to create an explosive ullage. A threat projectile was fired into the ullage to determine the effectiveness of the filler. Threat projectiles used in this test series were a high-explosive incendiary and an armor-piercing incendiary. Although final data reduction and evaluation of results are not yet complete, preliminary evaluations indicate that all of the fuel tank filler technologies significantly reduced the explosive overpressure compared to an unprotected baseline condition.

Phase II testing on installed AH-1S Cobra helicopter fuel tanks was done by installing the candidate fuel tank filler material, filling and draining the tank with JP-8, introducing JP-4S fuel vapor simulant to produce an explosive ullage, and firing the threat projectile into the ullage of the installed fuel tank. Phase II threats were the same as used in Phase I. Forward and aft fuel tanks were tested. Both fuel tanks are self-sealing. The forward tank is 190 gallons, and the aft is 92 gallons. As in the case of Phase I, complete data reduction and analysis of the results have not been completed. Preliminary evaluations indicate that all fuel tank filler technologies significantly reduced the explosive overpressure compared to that experienced when a threat projectile impacts the unprotected aircraft fuel tank.

- **PGU-28 LETHALITY JLF TESTS:** The U.S. 20 mm PGU-28/B SAPHEI (semi-armor piercing high explosive incendiary) projectile was developed in the mid 1980s as a replacement for the U.S. M-56A3 HEI projectile for use in the air-to-ground role due to its armor penetrating capability. Since it provided significant performance improvements in terms of drag, effective range, time of flight, and graze angle tolerance, it was decided the round would also be employed against air-to-air targets in gunnery scenarios. The PGU-28/B is the only projectile currently used by the Air Force and Navy for fixed-wing air-to-air combat. This projectile is fired from the M61A1 gun system that is utilized by the F-14, F-15, F-16, and F/A-18 aircraft. Current plans call for the use of the PGU-28/B with the M61A2 gun system on the F-22 aircraft. With the approximately 8,000,000 PGU-28/B rounds in the U.S. inventory, these tests will have a broad impact.

  While the PGU-28/B represents an improvement in aerodynamic performance, its lethality (damage capability given a hit) against actual aircraft targets has not been demonstrated. During FY00, the JLF program developed a plan to test the lethality of the PGU-28/B against selected targets, including a Soviet MIG-29 aircraft and Mil-24 Hind helicopter.

JTCG/AS

Fiscal Year 2000 marked the transition point for the Joint Technical Coordinating Group on Aircraft Survivability (JTCG/AS) from oversight by the Director, Test Systems Engineering and Evaluation (DTSE&E), USD(AT&L) to DOT&E/Live Fire Test, OSD. This transition was one of several actions recommended in the Defense Science Board's T&E study and report of FY99, and helps bring together the Live Fire Test program's efforts in survivability with other ongoing survivability activities.

The JTCG/AS is organized into three major sub-groups in order to focus their efforts in the areas of Vulnerability Reduction, Susceptibility Reduction, and Survivability Methodology. Past efforts have concentrated on these three distinct areas of survivability. Future efforts will start to focus on the synergistic benefits of addressing not only combat survivability, but aircraft safety as well. Also, since testing and modeling and simulation are integral parts of the scientific method, they will be focused to complement each other.

One of the most significant classes of threats to aircraft today is that of the MANPADS shoulder-launched, infrared, and radar-guided missiles. The JTCG/AS sponsored a national MANPADS workshop in FY00 to address this growing threat. Out of this came the culmination of the Joint Aircraft Survivability Against MANPADS study, a Joint Test and Evaluation Feasibility Study to generate test-validated joint tactics, techniques, and procedures. The Advanced Survivability Rotorcraft Project, initiated in FY00, is a first step in achieving rotorcraft survivability to MANPADS. Concurrently, the MANPADS Threat Characterization Project was also initiated to enable high-quality vulnerability assessments and risk characterization.

New and future aircraft will utilize weapons bays versus externally carried munitions. A weapons bay ablative protection "Proof of Concept" project is starting in FY01. It will determine the lowest weight combination of ablative and intumescent materials to protect the weapons bay against ballistic impacts. It will culminate in full-scale ballistic tests with live munitions.

JTCG/AS efforts in fire detection and suppression have been benefiting front line fighter aircraft for many years. These technologies have a great potential for re-use in commercial airliners, and will aid the Federal Aviation Administration (FAA) in achieving improved passenger safety. The JTCG/AS has conducted research and implemented engine computer software able to detect, identify, and mitigate engine damage. This technology has been developed and implemented on an F/A-18E/F F414 test engine. This type of technology research will also be used to enhance the Joint Strike Fighter engine development program.

The JTCG/AS has also completed the design, development, and test of a new cellular design, all composite, hydrodynamic ram tolerant, survivable fighter wing utilizing decoupled fuel cells. Wing and tail geometry's of the Joint Strike Fighter and Unmanned Combat Aerial Vehicle are appropriate for considering the cellular wing manufacturing approach, and the cellular co-cure technique may also be suitable for consideration in spacecraft structural designs.

The JTCG/AS jointly funded the Active Core Exhaust (ACE) project with the Air Force and the Defense Advanced Research Projects Agency to remove the core thrust reversers of a high by-pass engine, modifying the signature and heat generation of the engine exhaust. During summer 2000, ACE was tested on a C-17 engine test stand. Preliminary results indicate the design met its objectives; a flight test is being planned in FY01 to evaluate the full impact of the ACE design as installed on a C-17.

The JTCG/AS currently has four major methodology focus areas: (1) survivability model and simulation credibility; (2) transition to a new modeling architecture; (3) a new physics-based ballistic vulnerability simulation; and (4) an integrated survivability assessment process. The JTCG/AS has established the Joint Accreditation Support Activity to assess, improve, and document the credibility of approved survivability models available through the Survivability/Vulnerability Information Analysis Center (SURVIAC). The DDOT&E/LFT chairs the Senior Steering Group of SURVIAC.

The Joint Modeling and Simulation System (JMASS) is a new architecture being developed for creating new engagement-level models. The JTCG/AS is identifying and supporting ways to integrate JMASS models into simulations and leverage existing Joint Service infrastructures to address long-term distribution and configuration management of JMASS simulations.

The JTCG/AS, in cooperation with the Joint Technical Coordinating Group for Munitions Effectiveness (JTCG/ME) and the Army Research Laboratory, continues efforts in FY00 to develop a new physics-based simulation to assess the vulnerability of a wide range of targets as well as the lethality of many types of munitions. The Advanced Joint Effectiveness Model (AJEM) is hoped to have the capability to calculate damage effects on a target system and determine the impact of that damage on the ability of the system to function.

The current method of aggregating results of engagement models, for use in mission and campaign simulations, is inadequate to make trade-offs between survivability enhancement features. The JTCG/AS is developing an Integrated Survivability Assessment approach that will allow for balanced and robust M&S across the survivability spectrum at the engagement mission and campaign levels.

JTCG/ME

Fiscal Year 2000 also marked the transition of the Joint Technical Coordinating Group for Munitions Effectiveness (JTCG/ME) from the oversight by the Director, Test Systems Engineering and Evaluation (DTSE&E), USD(AT&L) to DOT&E/Live Fire Test, OSD. The JTCG/ME is the sole DoD organization chartered to publish joint Service-authenticated, non-nuclear weapons effectiveness data for use by the Department. These publications, called Joint Munitions Effectiveness Manuals (JMEMs), are the "how to" manuals for putting ordnance on target, and as such, directly impact combat readiness, effectiveness, and survivability. Weapons effectiveness data are available in both paper and electronic media (CD-ROMs, diskettes, and via classified computer networks). The JTCG/ME also develops and standardizes methodologies for evaluation of munitions effectiveness and maintains data bases for target vulnerability, munitions lethality, and weapon system accuracy.

Revisions to DoD 5000.2-R in FY00 now require that data be provided for the preparation of JMEMs data prior to the fielding of any major weapons platform or weapons system.

JMEMs are used by the warfighters in operational weaponeering, mission planning and training; the DoD, Joint, and Service planners in force-on-force modeling, mission area analysis, QDR, and requirements studies and weapon procurement planning (CBMR); and by the service acquisition community in performance assessment, analysis of alternatives, and survivability enhancement studies.

In FY00 the JTCG/ME executed the following work program:

- Completed conversion/updates of existing JMEMs and JTCG/ME Special Reports to CD-ROMs (i.e., JMEM Air-to-Surface Weaponeering System (JAWS) v2.1, Joint Anti-air Combat Effectiveness-Air Defense (J-ACE: AD) v1.0, JMEM/Surface-to-Surface Weaponeering Effectiveness System (JWES) v1.0, Special Operations Target Vulnerability and Weaponeering Manual v2.0, and Target Vulnerability Manual for JAWS v2.1, Joint Anti-air Combat Effectiveness-Air Superiority (J-ACE: AS) v2.0, Joint Anti-Air Combat Effectiveness-Air Defense (J-ACE: AD) v2.0, Joint Anti-air Combat Effectiveness-Ship Anti-air Warfare (J-ACE: Ship AAW) Prototype version, and JMEM/Surface-to-Surface Weaponeering Effectiveness System (JWES) v2.0.

- Distributed products, via the classified Internet, using the Joint Product and Information Access System (JPIAS) v1.0, (Books-on-line, Automated Products, Models, Tri-Service Data, and Support service).

- Expanded existing data bases to incorporate data for newly fielded weapons (i.e., Air-to-Surface Basic Manual-Revision 4 and Surface-to-Surface Direct/Indirect Fire).

- Addressed Target Vulnerability data generation and methodology improvements (e.g., buildings and content, rock penetration, agent release model, interdiction, fragment penetration equation standardization, and Operational Requirements-based Casualty Assessment (ORCA) extension).

- Continued the development of standardized models and methodology for Air-to-Surface, Surface-to-Surface, and Anti-air effectiveness calculations (i.e., Joint Anti-air Model

(JAAM) v2.0, delivery accuracy, building analysis, collateral damage, search/target acquisition, hardened targets, safe distances/risk to friendly troops, ship-to-ship gun effectiveness, dual stage warhead, directed energy weapons and Mean Area Effectiveness standardization).

- Conducted Configuration Management/Verification, Validation and Accreditation efforts on specific JTCG/ME models (i.e., Air Target Geometries, Blast Effectiveness Against Mobile Systems (BEAMS), ORCA, Penetration Curvilinear 3-D Model (PENCRV3D), Advanced Survivability Assessment Program (ASAP), Advanced Joint Effectiveness Model (AJEM), Modular Effectiveness/Vulnerability Assessment - Ground Fixed (MEVA-GF), Bridge Analysis System (BAS), Joint Service Endgame Model (JSEM), Joint Smart Weapons Module (JSWM), Joint Anti-air Model (JAAM), Simplified Artillery Effectiveness Model (ARTQUIK), Surface-to-Air Missile Site (SAMSITE), and Navy Gun Effectiveness Model (NGEM)).

- Together with JTCG/AS, continued to work the release of Advanced Joint Effectiveness Model v1.0 (with features including TBM Body-to-Body, Explosive Initiation, Hydrodynamic Ram, and Blast/Fragmentation Combined Effects) and the Joint Component Vulnerability Archive v1.0.

- Instituted an annual CINC data call to facilitate the development of a requirements driven program for FY01 and beyond.

In recognition of the vital importance of JMEMs, the JTCG/ME Program Objective Memorandum funding line was increased by $33.7 million over the Fiscal Year Defense Plan (FY02-07). This additional funding will reduce major methodology/data shortcomings, and ensure that JMEM data are available at Initial Operational Capability for most critical systems identified as highest priority by the operational CINCs. The funding will also increase weapons effectiveness data generation and documentation efforts to address highest priority CINC requirements, and help reduce CD-ROM update cycles to a maximum of fourteen months.

VULNERABILITY ASSESSMENT TO RADIO FREQUENCY THREATS

One of the roles of the LFT&E program is to assure that realistic testing is conducted using both current and future threats. This means ballistic and non-ballistic directed energy threats. There is a growing concern in some circles that as the U.S, becomes dependent upon computer-driven command and control, and as military digitization becomes the norm, that the possibility exists for a terrorist or rogue nation to seek to take advantage of this apparent vulnerability. We have supported the development of prototype High-Power Microwave (HPM) weapons and tests of these devices at DoD open-air ranges. As a result of these efforts, we now have some relevant equipment and experience with live fire testing of HPM weapons against military systems. However, additional program resources were needed to develop a more complete data base and experience in performing live fire tests using these non-traditional threats.

The U.S. Congress provided an initial increment of $4.0 million in FY99 to "expand threat vulnerability testing and evaluation to include the threat of Radio Frequency (RF) weapons." We prepared a broad agency announcement and subsequently published it in *Commerce Business Daily*. Twenty-eight responses (a mixture of submittals from both public and private sector vendors) were received in response to the announcement. A technical evaluation committee was convened, which subsequently evaluated the submitted proposals. In FY00, contracts were prepared and then awarded to 13 different companies and agencies. About one-quarter of the money was utilized for the development of a RF device, using components and technology from the open market.

The LFT&E Office conducted two RF vulnerability test series during FY00 at a DoD range. Both were outdoor, live fire, open-air tests oriented towards assessing the vulnerability of electronic-based systems representative of the U.S. commercial and military infrastructure to high-power ultra-wideband illumination under "operationally relevant" conditions.

Two different RF devices were employed; varying in waveform characteristics, rise time, pulse repetition frequency, burst length, and power levels. The targets tested included both a military weapon system and Commercial-Off-The-Shelf (COTS) technology. The COTS equipment was subdivided into two distinct sets: (1) industrial control and monitoring technology; and (2) medical equipment. The industrial control and monitoring technology included portable generators, power supplies, a physical security system, a fire monitoring and alarm system, a telephone-switching device, a baggage screening operator-assisted X-ray machine, a stand-alone emergency response system, and a ground-based navigation system.

Upsets and failures were more prevalent in the unhardened COTS equipment than in the hardened military weapon system, for which effects were minimal. The complete data is still being analyzed.

Plans for FY01 include: (1) conducting tests on two other military systems; (2) completion and testing of a new prototype ultra-wideband device built from readily available components (and with no access to classified target susceptibility data); (3) completion of calculations to relate transient electric fields inside a building to those incident on an exterior wall; (4) simulations of the effects of excess bit errors on the operability of the electronic units found in major weapons systems; and (5) completion of data analysis for tests already performed.

PART X

CINC SUPPORT

DOT&E CINC SUPPORT:
ACHIEVING JOINT INTEROPERABILITY

"I appreciate your personal concern in assisting this command in improving our combat readiness and look forward to similar support during future exercises."

R. Steven Whitcomb, Major General, US Army/Assistant Chief of Staff, US Forces Korea, J3

Experience has shown that achieving interoperability is a team effort. It cannot be accomplished by any single agency or organization working in isolation. We believe it must be done through effective partnerships, providing high levels of customer service, and offering state-the-art tools and products incorporating the best technology available to the warfighter. Year 2000 has been a year in which great strides were made toward understanding and achieving interoperability. Our on-site representatives are helping the CINCs achieve their goals by helping them measure their successes and understand and correct areas in need of improvement. This leads to better defined Joint requirements, which are both measurable and testable.

THE BENEFITS OF DOT&E'S PARTNERSHIP WITH THE CINCS

Test and Evaluation Expertise to CINC Warfighter

DOT&E's partnership with the CINCs has resulted in permanent improvements to the way CINCs plan their exercises and assess their interoperability readiness.

DOT&E supports the CINCs by providing the operational community with on-site test and evaluation expertise. This support began as a response to the CINC's need for assistance with the Y2K operational evaluations (OPEVALs). There was no standardized process for conducting these evaluations, no standardized training, and no consistent way to track the results. The CINCs had to not only conduct these OPEVALs, but had been directed by the Office of the Secretary of Defense to perform mission-centric testing in accordance with the Clinger-Cohen Act. This would have to be accomplished within existing staffing levels and with few, if any, additional resources. DOT&E offered the CINCs experienced personnel to assist the CINCs with planning, executing, and analyzing data for the operational evaluations.

On-site DOT&E representatives were placed at the CINCs to provide operational field experience, test and evaluation experience, and interoperability assessment processes that were tailored to each CINC's individual needs. The CINC Y2K OPEVALs were a success. However, they revealed more interoperability problems than Y2K problems. One of the major CINC challenges for Year 2000 was addressing the interoperability issues identified in the Y2K OPEVALs. DOT&E continues to provide assistance to the CINCs by capitalizing on the mission-centric focus of Y2K OPEVALs. CINC Y2K OPEVAL processes were refined and repackaged into an Operational Capability Assessment Process (OCAP) designed to measure outcome-based interoperability.

DOT&E on-site personnel provide technical assistance to U.S. Forces-Korea's (USFK) evaluations, helping to ensure the accomplishment of USFK's wartime missions. DOT&E provides support in planning, training, execution, and analysis of the evaluations, and the development of final reports, which were central to the success of two-major exercises. The goals of the annual Reception and Staging, Onward Movement and Integration (RSOI) Exercise were to: (1) meet theater-training objectives; (2) identify operational strengths that should be sustained; and (3) identify issues that would require additional focus. DOT&E support contributed significantly to the successful completion of this very challenging task. Particularly noteworthy was the thorough report prepared after the exercise that captured the observations and recommendations for improvement. Completion of ULCHI-FOCUS LENS, the world's largest simulation driven command post exercise, was a tremendous success due largely to technical assistance provided by DOT&E. Our support helped capture challenges and opportunities in the Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance (C^4ISR) interoperability area.

U.S. Pacific Command used DOT&E's on-site expertise and the Operational Capability Assessment Process (OCAP) during the critical planning and execution phases of the first JOINT MISSION FORCE COMMAND AND CONTROL EXERCISE. In the CINC's comments, the DOT&E team was singled out for providing a capability indispensable to the Pacific Command's planning, execution, analyses, and reporting efforts.

Similar on-site technical support is also being provided to CENTCOM, SOCOM, and EUCOM.

Standard Interoperability Assessment Process

The OCAP has been developed and undergoes continuous refinement to give operational personnel a simple, straightforward process to conduct interoperability assessments, either as a stand-alone assessment or in conjunction with an existing exercise. OCAP can be used as is or modified to accommodate local policy and procedure. It can be used in its entirety, but is broken down into sub-processes that can be applied as needed or wanted. The OCAP provides the CINCs with a method to report and track exercise results that can be monitored until issues are resolved or otherwise brought to closure.

DOT&E has also developed a web-based Resource Exchange Center to provide the CINCs with easy access to automated tools, training, and critical test and evaluation information. These sites are developed in collaboration with the hosting CINCs, with the USFK and JFCOM sites already being completed. Resource Exchange Centers for additional CINCs will be developed at later dates. The sites allow the CINCs to provide DOT&E with feedback on improvement to resources and where on-site support is most needed—the ability to test interoperability in a Family of Systems Environment.

DOT&E CINC support also contributes to achieving Joint interoperability. DOT&E assists the CINCs in comparing and analyzing common interoperability issues and can help to evaluate those issues in context of a Family of Systems across the CINCs. Instead of looking at the performance of an individual system, the DoD can now evaluate how a system will impact overall mission performance and how individual systems operate in the entire Joint system architecture. Since interoperability consists of more than system-to-system connectivity, the CINC field environment allows the DoD to look at connectivity, processing, doctrine, training, protocols, and standards from a Joint perspective.

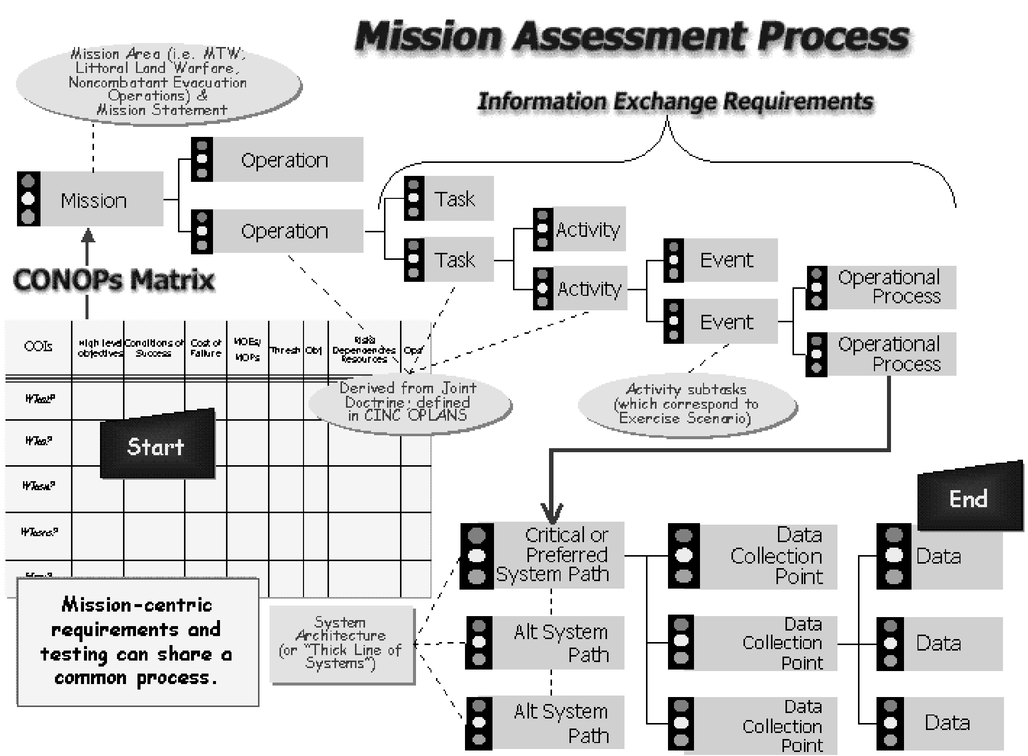
BRIDGING THE TEST COMMUNITY WITH THE REQUIREMENTS COMMUNITY: ACHIEVING OUTCOME-BASED INTEROPERABILITY

DOT&E's partnership with the CINCs helped identify interoperability as a significant DoD shortfall. Furthermore, this partnership brought the interoperability issue to the forefront of both the test and requirements communities. We helped DoD to shift from a system-centric focus to a Family of Systems/mission-centric focus required by the Clinger-Cohen Act. Our efforts to heighten the awareness of the Family of Systems and interoperability issues contributed to revising the documents that govern requirements generation, interoperability, and the overall acquisition process.

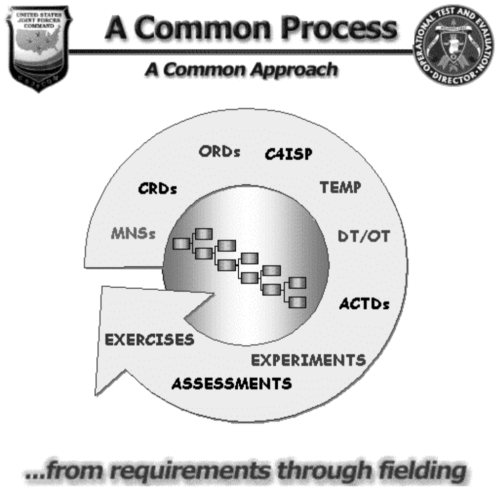
For the first time, requirements personnel are mandated to develop key interoperability requirements based on mission requirements that are both measurable and testable. This encourages early involvement of test personnel in the requirements development process. While the test community clearly must avoid even the appearance of influencing the development of requirements, there are real benefits from linking the requirements community to the test community. A better-defined requirement yields better testing.

Common Goal – Common Process- Common Approach

The requirements community and the test community both share two important goals – Joint interoperability and systems that better serve the warfighter. DOT&E developed the Mission Assessment Process (MAP) to support the CINCs with their test and exercise responsibilities. Shortly after the MAP was developed, Joint Forces Command, in its role as Joint integrator and reviewer of Capstone and Operational Requirements Documents, began to look at ways to train the requirements personnel to comply with new requirements policies focusing on interoperability. DOT&E offered processes to JFCOM to help train requirements personnel to develop better operational concepts that could be traced to key interoperability concerns – firmly rooted in Joint operational missions.

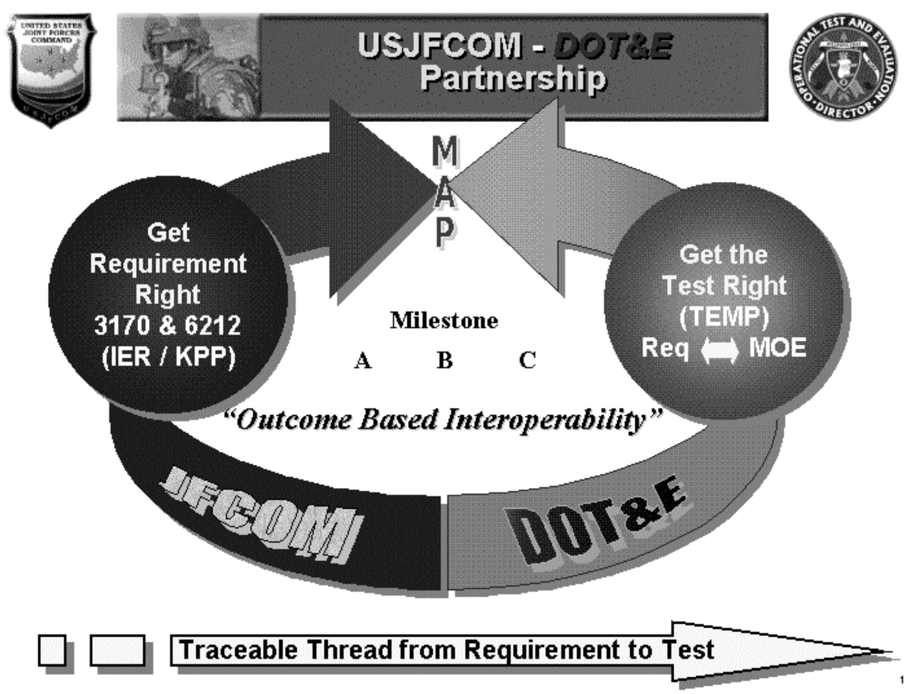


It is particularly noteworthy that our on-site representative at U.S. Special Operations Command (SOCOM) participated in the development of SOCOM's new requirements generation system using concepts and processes developed by DOT&E for the CINCs. Having a representative in SOCOM will help provide invaluable lessons learned from this unique environment, and allow the other CINCs and services to incorporate them as they may apply.



The MAP was designed to facilitate the development of Mission Needs Statements, CRDs, and ORDs, as well as any type of test activity. It provides the standardization needed to address the interoperability challenges of the new millennium, the development of complex communications systems and Families of Systems (such as the Global Information Grid), and the realization of Joint Vision 2020. The MAP is being used to help JFCOM in its role as the Force Integrator, and is central to the partnership between DOT&E and JFCOM in addressing interoperability and integration issues that could threaten the modern warfighter.

DOT&E's Special Partnership with JFCOM - the Force Integrator



DOT&E supports U.S. Joint Forces Command in its role as Joint integrator and Joint experimenter by providing a model to facilitate the identification, testing, and resolution of common CINC issues. DOT&E, working in partnership with JFCOM, is helping the CINCs and services achieve interoperability.

The DOT&E on-site support at JFCOM is assigned to the Joint Interoperability and Integration Section. In this capacity, he can help all of the CINCs identify common issues from field exercises. He also acts as a liaison between CINCs and requirements personnel, providing two-way feedback. As requested, he provides requirements developers with test reports and analysis that could be used to augment available studies. This key position has resulted in dramatic opportunities to open channels of communication and provide new services to field personnel, testers, and the requirements community. By partnering with JFCOM, processes have been developed and improved, and on-site personnel have been strategically placed to help implement those processes. This is resulting in better tests, accountability for tracking and producing results, and implementing the corrective actions needed to achieve Joint interoperability. Working with JFCOM has allowed both DOT&E and JFCOM to achieve unprecedented customer service levels. This new partnership saves time, money, and will help streamline the requirements development process, and help testers yield better, more accurate results.

PART XI

YEAR 2000 (Y2K)

OPERATIONAL EVALUATIONS

UPDATE ON THE YEAR 2000 (Y2K):
OPERATIONAL EVALUATION EFFORT

CAPITALIZING ON THE Y2K EXPERIENCE

As everyone knows, the Year 2000 clock rollover turned out to be uneventful around the world. For the Department of Defense, major credit goes to the systematic planning and fixing that ensured that C^4I and information systems were ready to operate in the Y2K environment. In addition to the January 1, 2000 clock roll, there were concerns about the February 28-29 and March 1 rollovers. Since almost all of the systems and applications had been checked during the CINC OPEVALS in 1999, there were no surprises on these dates.

DOT&E's FY00 effort primarily focused on documenting the Y2K evaluation methodology and lessons learned. We then applied what we had learned in assessments of C^4I systems of United States Forces Korea (USFK) and Joint Forces Command (JFCOM).

Since the conclusion of the Y2K OPEVALs, DOT&E has continued initiatives resulting from the Y2K work. We sponsored representatives at the U.S. European Command, the Joint Forces Command, and United States Forces Korea, who work in areas related to operations planning, C^3, and interoperability. During August 2000, for example, we sent a team of nine people to support activities of USFK's annual Ulchi-Focus Lens 2000 command post exercise. This effort, which used the *thin lines* methodology developed for the Y2K OPEVALs, concentrated on activities related to understanding and improving operational processes for preparing target nominations in the development of the Integrated Tasking Order, and on intelligence dissemination with emphasis on requests for information and intelligence summaries. Our team's observations once again illustrated the complex interoperability demands of modern, computer-based Command, Control, Communication, Computer, and Intelligence (C^4I) systems, and aided USFK in meeting the extensive challenges of combined forces military operations. Figure 1 depicts the Korean locations for the Ulchi-Focus Lens effort.

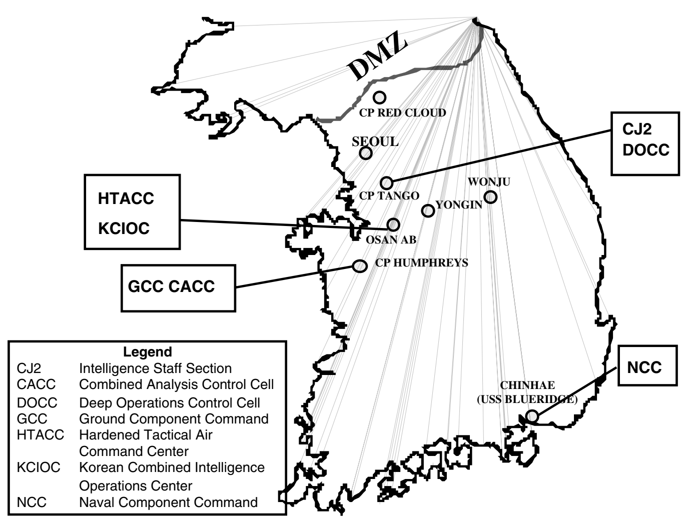


FIGURE 1. Leveraging Y2K Methodology for USFK

We will continue similar initiatives with other theaters so that the United States' Unified Commanders will be able to respond quickly to contingencies or threats to our vital national interests.

BACKGROUND INFORMATION

With the approach of the Year 2000 and the potential for catastrophic computer system problems, the Department of Defense began an extensive project intended to forestall trouble. Investing some $3.6 billion over 5 fiscal years, the Services, Agencies, and the Unified Commands looked into all possible areas where the millennium bug might appear. This culminated in an extensive series of operational evaluations by the Unified Commands, which found few substantive Y2K hazards, but did disclose some important interoperability problems. Although DoD had expected to unearth a lot of Y2K difficulties, the real benefit of the effort was to point out the need for continued attention to interoperability in our complicated C^4I system-of-systems.

Spending such a large amount of money brought with it the question, "Was it worth it?" In fact, it was money well spent. The greatest advantage came first in having the various CINCs determine the *thin lines* of mission critical command and control systems, and then in verifying warfighting system interoperability via operational evaluations. Thin lines are those minimum essential C^4I systems that allow each command to meet its critical mission and operational requirements; they would be the linchpin of operations in any contingency in a Y2K environment. Without this C^4I system-of-systems, modern military operations would not be possible. Moreover, the concept of defining and understanding the C^4I thin lines did not exist before DoD undertook this Y2K evaluation effort; how ready the commands would have been for war in the Year 2000 without the corrections we have made is problematical. We have, however, made such substantial improvements in understanding our C^4I systems that one cannot deny the value of our accomplishments.

THE METHODOLOGY

DOT&E provided support for Y2K verification activities worldwide, including expert assistance for cross-functional, inter-Service, and cross-system testing. The amount of effort that DOT&E provided varied by command, and was governed by the nature and complexity of each situation. The European Command (EUCOM) was heavily involved with the air war over Serbia; thus, DOT&E representatives assisted in key OPEVAL planning and conduct of the operational evaluations. Because of the rapid turnover of people assigned to Korea and the relatively small staff there, DOT&E, along with contractor support, made up a substantial part of the evaluation planning and assessment team. DOT&E contributed significantly to OPEVAL planning and execution in all of the commands.

Some of the most commonly recurring systems in the evaluations were the Local Area Networks (LANs), various electronic mail applications, secure and normal voice telephone and facsimile, the Secret Internet Protocol (SIPRNET), and the unclassified but sensitive Internet protocol (NIPRNET). In addition, each command evaluated a number of unique programs and applications. The most commonly encountered systems and applications fell in to three basic categories:

- Global Command and Control and Related Systems or Applications
- Intelligence Related Systems and Applications
- Communications

The Services conducted tests of individual systems at the program manager and command function levels. These tests were the basis for certifying individual systems as Y2K compliant. Subsequent CINC OPEVALs concentrated on mission-level activities, and primarily tested compliant systems for system-to-system interoperability in executing critical missions. Each CINC, however, oversaw and supervised testing the thin lines from sensor to shooter by his components and supporting agencies. Figure 2 illustrates Service/CINC evaluation responsibilities.

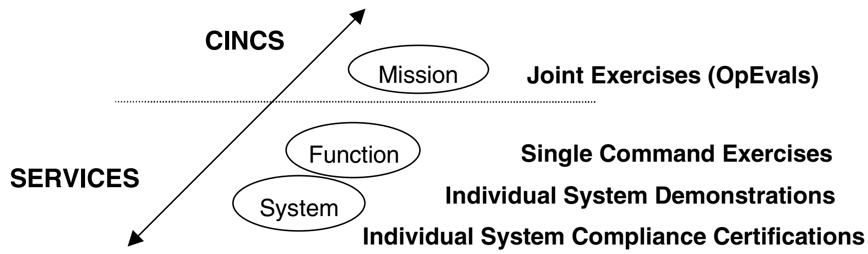


Figure 2. Service and CINC Y2K Verification Activities

Through extensive OPEVAL planning, the Department of Defense identified 2,107 mission critical systems and 4,749 non-mission critical systems. Of the 2,107, the Joint Staff included 452 in their Master CINC Thin Line List; these were the primary systems addressed during the CINC Y2K OPEVALs. It was not necessary to evaluate each of the 452, however. Several were trusted systems and some had no date processing functions, leaving a total of 358. The individual Services or Agencies tested and evaluated the remainder, ensuring that they became Y2K compliant, if necessary.

All of the commands learned a great deal about their current capabilities as well as how they can be improved. Perhaps the most important single benefit came from the homework that needed to be done prior to the exercises. To prepare for the OPEVALs, the commands identified their critical missions and subordinate critical mission support tasks, and then developed their thin lines according to their mission requirements. Thus, a major result of the Y2K OPEVALs was the definition and critical review by the Unified Commands of their C^4ISR infrastructure from the perspective of operational rather than technical capability. Upon analyzing their enterprise processes, the CINCs found only a third of their systems, on average, to be critical.

THE OUTCOME: RELEARNING INTEROPERABILITY AND CONFIGURATION MANAGEMENT LESSONS

The OPEVALs were, in general, very successful, detecting a total of 34 hard failures and 8 soft failures. Specific Y2K-related failures are classified. Table 1 depicts the type of Y2K faults noted and the actions taken to fix them.

Table 1. CINC OPEVAL System Failures

CINC	Hard Failure	Soft Failure	STATUS Fixed H / S	Under Review H / S	Delayed Fielding H / S	Fix Planned H / S	No Action H / S
JFCOM	3	0	3/0	0	0	0	0
CENTCOM	5	0	1/0	1	2	0	1
EUCOM	2	0	2 / 0	0	0	0	0
PACOM	2	0	2 / 0	0	0	0	0
USFK	5	0	2 / 0	0	0	1	2
SOCOM	3	0	0 / 0	0	0	1	2
SOUTHCOM	1	0	1 / 0	0	0	0	0
SPACECOM	4	4	2 / 3	2 / 0	0 / 0	0 / 0	0 / 1
NORAD	1	2	1 / 2	0	0	0	0
STRATCOM	0	0	0	0	0	0	0
TRANSCOM	8	2	5 / 0	0 / 1	0 / 0	0 / 1	3 / 0
TOTAL	**34**	**8**	**19 / 5**	**3 / 1**	**2 / 0**	**2 / 1**	**8 / 1**

Legend:
H / S = Hard Failure/ Soft Failure
No Action = No Action Taken; No good fix currently available; No fix planned; or No fix–System to be Replaced.

Throughout the OPEVALs, two issues appeared among the commands with some regularity. First was the need for *continuous configuration management*. Often, agencies or offices had installed new or different applications or programs on their computers. These differences prevented locations or offices from communicating with each other unless the applications became standard. Despite efforts to control configuration management, another difficulty cropped up everywhere: incompletely addressed or unresolved problems with *joint interoperability*. Configuration management was vital to ensure that the command had installed and used only Y2K-certified systems and applications. Joint interoperability problems arose because many commands and Services employed systems that, although aimed at similar goals, could not work together or be accessed and employed by others, thus causing needless duplication and work. The two issues overlapped when commands or components used different versions of the same application or system, thus rendering them wholly or partially incompatible.

The commands also encountered an old problem that nobody should forget: organizations had failed to exercise their systems and capabilities to make sure that they worked. For example, one of the commands held a rehearsal of staff activities for the Y2K rollover period. This command intended to use satellite communication terminals and UHF and EHF radios in the event its computer-based systems failed. These backup systems had not been used for extended time periods, several years for some of the pieces. When the rehearsal began, the players discovered that all of the equipment had been stored or turned off for so long that *none* of the alternate communications worked. Several days elapsed before parts could be obtained to correct the problems or bring the equipment up to date.

CINCs found that they could perform their critical missions during and after Y2K date changes. The tests found several problems with thin line systems, both Y2K and non-Y2K related. These were generally resolved using alternate systems plus manual procedures short of full contingency plans. Y2K problems consisted of three types. Some were system interoperability failures, in which each of two systems operated as intended but the systems had a Y2K interoperability problem. In other cases, systems and peripherals such as printers did not interoperate properly. Sometimes, systems that had previously been certified as Y2K compliant had newly identified Y2K system failures. These Y2K problems consisted of such simple things as incorrect dates on message headers or facsimile transmissions, with no other effects on content, function, or operation. In other cases, the problems were severe enough to cause incorrect transmission or exchange of data or imagery.

Non-Y2K problems discovered during the OPEVALs centered on issues of configuration management and the tendency for people to install new versions of a variety of applications or systems on their computers without regard to Y2K certification, as well as problems with joint interoperability. Non-Y2K issues also included previously unrecognized, everyday midnight crossing anomalies, obsolete software on particular installations, and known bugs that were to be corrected in software updates. Usually, the non-Y2K problems were corrected prior to the end of an OPEVAL, but configuration management difficulties were prevalent and presented a major area requiring attention by commanders.

THE IMPORTANCE OF CONTINUED INTEROPERABILITY EVALUATIONS

Since the C^4ISR infrastructure is in a state of continual change, and because the OPEVALs helped in identifying C^4ISR architectures and thin line critical systems, the Department of Defense should consider institutionalizing the periodic conduct of OPEVALs, focusing on interoperability possibly once every three or four years. Several agencies could assist such evaluations, including the new Director of Interoperability, the Joint Interoperability Test Center, Joint Forces Command, and DOT&E. Such periodic exercises would update the Unified Commands' assessments of their ability to meet mission requirements, allow them to verify interoperability of existing systems and new programs, and identify those systems that could be eliminated. A recurring issue throughout all of the commands was the realization that people and agencies that believe they are working with similar (even the same) programs find out that these systems do not always interoperate flawlessly. The Y2K OPEVALs illustrated that to have systems and users ready for an emergency, they and the people who operate them must be exercised frequently.

GLOSSARY OF ACRONYMS

GLOSSARY OF ACRONYMS

30SW	30th Space Wing
45SW	45th Space Wing
46TG	46th Test Group
46TW	46th Test Wing
4BN	Four Bladed UH-1N
4BW	Four Bladed AH-1W
A/W/E	Aircraft/Weapon/Electronics
AAA	Anti-Aircraft Artillery
AAAV	Advanced Amphibious Assault Vehicle
AAC	Air Armament Center
AAE	Army Acquisition Executive
AAED	Advanced Airborne Expendable Decoy
AATC	Air National Guard Air Force Test Center
AAV	Assault Amphibious Vehicles
AAW	Anti-Air Warfare
ABL	Airborne Laser
ABLE-ACE	Airborne Laser Extended Atmospheric Characterization Experiment
ABLE-X	Airborne Laser Experiment
ABNCP	Airborne Command Post
ABU	E-6A Avionics Baseline Upgrade
AC/RC	Active Component and Reserve Component Systems
ACAT	Acquisition Category
ACC	Air Combat Command
ACDS	Advanced Combat Direction System
ACE	AMRAAM Captive Equipment
ACE	Analysis Control Element
ACE	Active Core Exhaust
ACETEF	Air Combat Environment Test and Evaluation Facility
ACF	Aerial Cable Facility
ACIS	Advanced Control Indicator System
ACS	Air Combat Simulator
ACTD	Advanced Concept Technology Demonstration
ADCAP	Advanced Capability
ADM	Acquisition Decision Memorandum

ADP	Automated Data Processing
ADS	Advanced Deployable System
ADVCAP	Advanced Capability
AEDC	Arnold Engineering Development Center
AEHF	Advanced Extremely High Frequency
AESA	Advanced Electronically Scanned Array
AFAS	Advanced Field Artillery System
AFB	Air Force Base
AFES	Automatic Fire Extinguishing System
AFFTC	Air Force Flight Test Center
AFIT	Air Force Institute Of Technology
AFIWC	Air Force Information Warfare Center
AFMSS	Air Force Mission Support System
AFOTEC	Air Force Test and Evaluation Command
AFOTEC	Air Force Operational Test and Evaluation Center
AFRL	Air Force Research Laboratory
AGS	Armored Gun System
AHIP	Advanced Helicopter Improvement Program
AIEWS	Advanced Integrated Electronic Warfare System
AIM-9X	Air Intercept Missile
AIRCMM	Advanced Infrared Countermeasure Munition
AIS	Automated Information System
AJ	Antijam
AJEM	Advanced Joint Effectiveness Model
ALCS	Airborne Launch Control System
ALFS	Airborne Low Frequency Sonar
ALI	Aegis LEAP Intercept
AMC	Army Materiel Command
AMC	Air Mobility Command
AME	Automated Maintenance Environment
AMP	Aircraft Modernization Program
AMPS	Aviation Mission Planning System
AMRAAM	Advanced Medium Range Air-to-Air Missile
AMSAA	Army Materiel Systems Analysis Agency
ANG	Air National Guard
AO	Action Officer

AOA	Analysis of Alternatives
AOD/MOD	Army's Area Oriented Depot Modernization
AOR	Area Of Responsibility
AOSN	Attack Operations Simulation Network
AP	Armor Piercing
APAM	Anti-Personnel, Anti-Materiel
APB	Acquisition Program Baseline
APES	Automated Patient Evacuation System
APFSDS-T	Armor-Piercing Fin-Stabilized Discarding Sabot-Tracer
APG	Aberdeen Proving Ground
APREP	AMRAAM Producibility Enhancement Program
APU	Auxiliary Power Unit
AQF	Army Advanced Quick Fix
AR	Augmented Reality
ARG	Amphibious Ready Group
ARPDD	Advanced Radar Detection and Discrimination
ARTM.	Advanced Range Telemetry
ASARC	Army System Acquisition Review Council
ASAS	All Source Analysis System
ASCIET	All Service Combat Identification Evaluation Team
ASCM	Anti-Ship Cruise Missile
ASE	Aircraft Survivability Equipment
ASIP	Advanced SIP
ASM	Armored Systems Modernization
ASPJ	Airborne Self Protection Jammer
ASR	Advanced Special Receiver
ASROC	Antisubmarine Rocket
ASTE	Advanced Strategic Tactical Expendable
ASTOVL	Advanced Short Take-Off Vertical Landing
ASV	Airborne Separation Video
ASW	Antisubmarine Warfare
ASWCS	ASW Combat System
ATACMS	Army Tactical Missile System
ATAP	Alternative Technology and Approaches Project
ATARS	Advanced Tactical Aerial Reconnaissance System
ATAS	Air-to-Air Stinger

ATC	Air Traffic Control
ATC	Aberdeen Test Center
ATCALS	Air Traffic Control and Landing System
ATCCS	Army Tactical Command and Control System
ATD	Advanced Technology Demonstration
ATEC	Army Test and Evaluation Command
ATF	Amphibious Task Force
ATFLIR	Advanced Targeting Forward Looking Infrared
ATIRCM/CMWS	Advanced Threat Infrared Countermeasures/Common Missile Warning System
ATP-1	Authority to Proceed-1
ATRJ	Advanced Threat Radar Jammer
ATRWR	Advanced Threat Radar Warning Receiver
ATT	Aided Target Tracking
ATWCS	Advanced Tomahawk Weapon Control System
AUR	All-Up-Round
AUTEC	Atlantic Undersea Test and Evaluation Center
AUTODIN	Automatic Digital Network
AVLB	Armored Vehicle Launched Bridge
AVTB	Aviation Test Bed
AVTR	Aviation Video Tape Recorder
AWACS	Airborne Warning and Control System
AWC	Air Warfare Center
AWE	Advanced Warfighting Experiments
AWS	Aegis Weapon System
BAT	Brilliant Anti-armor Technology
BCIS	Battlefield Combat Identification System
BDAR	Battle Damage Assessment and Repair
BFVS	Bradley Fighting Vehicle Systems
BG	Battle Group
BIT	Built-In Test
BIT/BITE	Built-In-Test and Built-In-Test Equipment
B-LRIP	Beyond Low Rate Initial Production
BLSM	Base Level System Modernization
BM/C^3I	Battle Management/Command, Control, Communications, and Intelligence
BM/C^4I	Battle Management Command, Control, Communications, Computers, and Intelligence

BMC^3	Battle Management, Command, Control, and Communications
BSM	Business Systems Modernization
BU	Block Upgrade
BUR	Bottom Up Review
BVT	Ballistic Vulnerability Test
C^2	Command and Control
C^3I	Command, Control and Communications Intelligence
C^3S	Command, Control and Communications Systems
C^4ISR	Command, Control, Communications, Computers, Intelligence, Surveillance and Reconnaissance
CABS	Cockpit Air Bag System
CAIV	Cost As An Independent Value
CALF	Common Affordable Lightweight Fighter
CALS	Computer Aided Logistics Support
CAMIS	Continental Army Management Information System
CAP	Corrective Action Plan
CAS	Close Air Support
CAST	Computer Adaptive Screening Tests
CATB	Combat Aviation Training Brigade
CAX	Computer-Assisted Exercises
CBASS	Common Broadband Advanced Sonar System
CCAS	Cape Canaveral Air Station
CCPDSR	Command and Control Processing and Display System Replacement
CCRP	Carry Reliability Program
CCS	Command and Control Section
CCTT	Close Combat Tactical Trainer
CDA	Central Design Activity
CDI	Classification, Discrimination and Identification
CDL	Common Datalink
CDR	Critical Design Reviews
CDRR	Concept Demo and Risk Reduction
CDS	Combat Direction System
CDT	Contractor Development Test
CDU	Capacitive Discharge Unit
CEC	Cooperative Engagement Capability
CEFMS	Corps Of Engineers Financial Management System

CEP	Cooperative Engagement Processor
CEP	Concept Evaluation Plan
CFC	Combined Forces Command
CFO	Chief Financial Officer
CGS	Common Ground Station
Chem Demil	Chemical Demilitarization
CHS-2	Common Hardware and Software-2
CHSSI	Common HPC Software Support Initiative
CICS/ESA	Customer Information Control System
CID	Commander's Independent Display
CIGSS	Common Imagery Ground/Surface System
CINC	Commander in Chief
CIP	Central Integrated Processor
CIS	Clinical Information System
CIS	Close-In Search
CITP	Common Integrated Tactical Picture
CIWS	Phalanx Close-In Weapon System CIWS
CLOAR	Common Low Observable Autorouter
CLU	Command Launch Unit
CLZ	Craft Landing Zone
CMBRE	Common Munitions BIT/Reprogramming Equipment
CMOS	Cargo Movement Operations System
CMUP	Conventional Mission Upgrade Program
CMWS	Common Missile Warning System
CNMS	Communications and Navigation Management System
CNO	Chief of Naval Operations
COEA	Cost and Operational Effectiveness Analysis
COI	Critical Operational Issue
COIC	Critical Operational Issues and Criteria
COIL	Chemical Oxygen Iodine Laser
COMOPTEVFOR	Navy Commander, Operational Test and Evaluation Force
COMPASS	Common Operational Modeling, Planning and Simulation Strategy
COMSEC	Communications Security
CONOPS	Concepts Of Operation
CONUS	Continental United States
COOP	Craft Of Opportunity

COT-DV	Common Torpedo Development Vehicle
COTS	Commercial-Off-The-Shelf
CPCRs	Computer Program Change Requests
CPMS	Civilian Personnel Management Service
CPR	Computer-Based Patient Record
CRD	Capstone Requirements Document
CRTC	Cold Regions Test Center
CSAR/SWS	Combat Search and Rescue/Special Warfare (Overland) Support
CSC	Conventional Systems Committee
CSDP	Chemical Stockpile Disposal Project
CSEL	Combat Survivor Evader Locator System
CSEPP	Chemical Stockpile Emergency Preparedness Project
CSSCS	Combat Service Support Control System
CSSQT	Combat System Ship Qualification Trials
CSS-R	Communications System Segment-Replacement
CSUs	Customer Support Units
CT	Confirmatory Test
CTEIP	Central Test and Evaluation Investment Program
CTGM	Combined Toxic Gas Model
CTOL	Conventional Takeoff and Landing
CTPS	Combat Trauma Patient Simulation
CTWG	Combined Test Working Group
CUs	Cooperating Units
CV	Aircraft Carrier Suitable
CVM	Change Verification Motors
C-X	Cargo-Experimental
DAAS	DoD Advanced Automation System
DAB	Defense Acquisition Board
DACS	Divert Attitude and Control System
DAES	Defense Acquisition Executive Summary
DAMA	Demand Assigned Multiple Access
DAMMS-R	Department of the Army Movement Management System–Redesign
DAPS	Deployable Aircraft Planning System
DARO	Defense Airborne Reconnaissance Office
DARPA	Defense Advanced Research Projects Agency
DASR	Digital Airport Surveillance Radar

DAWMS	Deep Attack Weapons Mix Study
DB2	Data Base 2
DBMS	Data Base Management System
DDDR&E(T&E)	Deputy Director, Defense Research and Engineering (Test and Evaluation)
DDR&E	Director, Defense Research and Engineering
DDRT	Defense Distribution Depot, Red River, Texas
DDS	Data Distribution System
DEM/VAL	Demonstration/Validation
DESA	Defense Evaluation Support Agency
DFAS	Defense Finance and Accounting Service
DIA	Defense Intelligence Agency
DII/COE	Defense Information Infrastructure and Common Operation Environment
DIMSS	Dynamic Interface Modeling and Simulation System
DIPC	Defense Information Processing Center
DIS	Distributed Interactive Simulation
DISA	Defense Information Systems Agency
DISALT	Dismounted Infantryman Survivability and Lethality Testbed
DISN	Defense Information Systems Network
DJAS	Defense Joint Accounting System
DJMS	Defense Joint Military Pay System
DJMS-AC	Defense Joint Military Pay System - Active Component
DLA	Defense Logistics Agency
DLP	Digital Light Processor
DMC	Defense Megacenter
DMLSS AIS	Defense Medical Logistics Standard Support Automated Information System
DMR	Defense Management Review
DMRIS	Defense Medical Regulating Information System
DMRS	Diary Message Reporting System
DMS	Defense Message System
DMS	Defensive Management System
DOE	Department of Energy
DoN	Department of the Navy
DOT&E	Director, Operational and Test Evaluation
DPG	Dugway Proving Ground
DPICM	Dual Purpose Improved Conventional Munition
DPPS	Defense Procurement Payment System

DPSC	Defense Personnel Support Center
DRB	Defense Resources Board
DREN	Defense Research and Engineering Network
DRR	Deployment Readiness Review
DSARC	Defense Systems Acquisition Review Council
DSB	Defense Science Board
DSDC	DLA Systems Design Center
DSMC	Defense Systems Management College
DSP	Defense Support Program
DSREDS	Army's Digital Storage and Retrieval Engineering Data System
DSS	Decision Support System
DSUFTP	Dual Station Unit Fielding and Training Program
DSUP	Defensive System Upgrade Program
DSVM	Degraded States Vulnerability Methodology
DSWA	Defense Special Weapons Agency
DT	Developmental Testing
DT&E	Development Test and Evaluation
DT/OT	Developmental Testing/Operational Testing
DT-1	Developmental Test-1
DTC-2	Desktop Tactical-Support Computer 2
DTED	Digital Terrain Elevation Data
DTR-1A	Developmental Test Round-1A
DTS	Defense Transportation System
DTSE&E	Director, Test Systems Engineering and Evaluation
DTTSG	Defense Test and Training Steering Group
DTWA	Dual Trailing Wire Antenna System
DVS-G	AT&T's Video Services-Global
DVT	Design Verification Test
EA	Electronic Attack
EA	Executive Agent
EADSIM	Extended Air Defense Simulation
EAM	Emergency Actions Messages
EBC	Embedded Battle Command
EC/EDI	Electronic Commerce/Electronic Data Interchange
ECAMS	Enhanced Comprehensive Asset Management System
ECCM	Electronic Counter Countermeasures

ECM	Electronic Countermeasure
ECP	Engineering Change Proposal
ECS	Environmental Control System
ECS	Exterior Communications System
ECU	Executive Control Unit
ECU/PPU	Environmental Control Unit/Primary Power Unit
EDCARS	Air Force's Engineering Data Computer Assisted Retrieval System
EDM	Electronic Document Management
EDP	Event Design Plan
EDT/VRM	Engineering Development Test/Vulnerability Reduction Measures
EELV	Evolved Expendable Launch Vehicle
EFOGM	Enhanced Fiber Optic Guided Missile
EFP	Explosively Formed Penetrator
EFT	Electronic Funds Transfer
EHF	Extra High Frequency
EHF	Extremely High Frequency
EIS	Executive Information System
EIS	Environmental Impact Statement
EKV	Exoatmospheric Kill Vehicles
EMD	Engineering and Manufacturing Development
EO/IR	Electro-Optical/Infrared
EOA	Early Operational Assessment
EPG	Electronic Proving Ground
EPIP	Evolutionary Phase Implementation Plan
EPLRS	Enhanced Position Location Reporting System
EPP	Enhanced Producibility Program
EPROM	Erasable Programmable Read Only Memory
ERDLVA	Extended Range Dual Log Video Amplifier
ESA	Enterprise Systems Architecture
ESAMS	Enhanced Surface-To-Air Missile Simulation
ESI	Extremely Sensitive Information
ESIT	Extended System Integration Test
ESM	Electronic Support Measures
ESSM	Evolved Sea Sparrow Missile
EST	Enlisted Screening Test
ET	Embedded Training

ET&C	Extended Tracking and Control
ETC	Echo Tracer Classifier
ETOS	Effective Time On Station
ETR-1A	Environmental Test Round-1A
ETRAC	Enhanced Tactical Radar Correlator
EUE	Extended User Evaluation
EUIT	Early User Innovative Test
EWAISF	Electronic Warfare Avionics Integration Support Facility
EWTES	Electronic Warfare Threat Environment Simulation
FAA	Federal Aviation Administration
FAAD	Forward Area Air Defense
FAAD C^3I	Forward Area Air Defense Command, Control, Communications, and Intelligence
FAADS	Forward Area Air Defense System
FAASV	Field Artillery Ammunition Support Vehicle
FARV	Future Ammunition Resupply Vehicle
FAS	Fuels Automated System
FAT	First Article Test
FBCB2	Force XXI Battle Command, Brigade and Below
FBM	Fleet Ballistic Missile
FCR	Fire Control Radar
FCS	Forward Customer Support
FCS	Fire Control System
FCT	Foreign Comparative Test
FDDI	Fiber-Optic Distributed Data Interface
FDE	Force Development Evaluation
FDL	Fighter Data Link
FDS	Fixed Distributed System
FDS	Flight Demonstrations System
FDTE	Force Development Test and Experimentation
FEP	Fleet Satellite EHF Package
FFAR	Folding Fin Aerial Rocket
FFRDC	Federally Funded Research and Development Center
FLIR	Forward Looking Infrared Radar
FM	Frequency Modulation
FMC	Fully Mission Capable

FMFIA	Federal Managers Financial Integrity Act
FMS	Flight Mission Simulator
FMSO	Fleet Material Support Office
FMTV	Family of Medium Tactical Vehicles
FOC	Full Operational Capability
FOEX	Follow-On Operational Experiment
FOFTP	Follow-On Flight Test Program
FOT&E	Follow-On Operational Test and Evaluation
FOTD	Fiber Optics Towed Decoy
FOTP	Follow-On Test Program
FOTT	Follow-On To TOW
FQT	Formal Qualification Testing
FSD	Full Scale Development
FSO	Financial Systems Organization
FSST	Full Ship Shock Tests
FT	Field Test
FTB	Flying Test Bed
FUE	First Unit Equipped
FUNOPS	Functional Operational Support
FY	Fiscal Year
FYDP	Fiscal Year Defense Plan
GAO	General Accounting Office
GATS/GAM	GPS-Aided Targeting System/GPS-Aided Munition
GBCS-H	Army Ground-Based Common Sensor-Heavy
GBCS-L	Army Ground-Based Common Sensor-Light
GBI	Ground-Based Interceptor
GBS	Ground-Based Sensor
GBS	Global Broadcast Service
GBTS	Ground Based Training System
GCAS	Ground Collision Avoidance System
GCCS	Global Command and Control System
GCSS	Global Combat Support System
GCSS-AF	Global Combat Support System – Air Force
GEO	Geosynchronous
GIAT	Government Installation and Acceptance Test
G-LOC	Gravitational-Induced Loss of Consciousness

GMLRS	Guided Multiple Launch Rocket System
GNU	Guidance Navigation Unit
GOLD	Government On-Line Data
GOTS	Government-Off-the-Shelf
GPS	Global Positioning System
GRP	Guidance Replacement Program
GRP	Glass-Reinforced Plastic
GSM	Ground Station Module
GTN	Global Transportation Network
GWS	Gun Weapon System
HAE	High Altitude Endurance
HARM	High-Speed Anti-Radiation Missiles
HCI	Human Computer Interfaces
HDR	High Data Rate
HELSTF	High Energy Laser Systems Test Facility
HEO	Highly Elliptical Orbit
HE-WAM	Hand Emplaced Wide Area Munition
HHR	Hand-Held Radio
HIMARS	High Mobility Artillery Rocket System
HITL	Hardware-in-the-Loop
HMI	Human Machine Interface
HMMWV	High Mobility Multi-Purpose Wheeled Vehicle
HOLC	High Order Language Computer
HPC	High Performance Computing
HPCMP	High Performance Computing Modernization Program
HPM	High-Power Microwave
HPTS	High Power Transmit Set
HTPS	Hull-Turret Position
HUD	Heads Up Display
HWIL	Hardware-In-The-Loop
I&M	Investment and Modernization
I^2	Image Intensified
IADS	Integrated Air Defense System
IAV	Interim Armored Vehicle
IBAS	Improved Bradley Acquisition System
ICAP	Improved Capability

ICAP II	Improved Capability II
ICBM	Intercontinental Ballistic Missile
ICD	Improved Countermeasures Dispenser
ICH	Improved Cargo Helicopter
ICOM	Integrated COMSEC
ICP	Inventory Control Point
ICSTF	Integrated Combat Systems Test Facility
IDECM	Integrated Defensive Electronic Countermeasures
IDP	Interface Data Processor
IEWCS	Intelligence and Electronic Warfare Common Sensor
IEWS	Integrated Electronic Warfare System
IFCS	Improved Fire Control System
IFF	Identification-Friend Or Foe
IFT	Integrated Flight Test
IGT	Integrated Ground Test
IHAT	Integrated Hardware-in-the-Loop Avionics Test
IIPT	Integrating IPT
IIR	Imaging Infrared
ILC	Initial Launch Capability
ILMS	Improved Launcher Mechanical System
ILS	Instrument Landing System
ILS	Integrated Logistics Support
IM	Insensitive Munition
IMA	Intermediate Maintenance Activity
IMDS	Integrated Maintenance Data System
INC	Internet Controller
INMARSAT	International Maritime Satellite
INS	Inertial Navigation System
InSb	Indium Antimonide
IOC	Initial Operational Capability
IOT	Initial Operational Test
IOT&E	Initial Operational Test and Evaluation
IP	Internet Protocol
IPDS	Improved Positioning and Determining System
IPDS	Interim Improved Positioning and Determining System
IPR	In-Process Review

IPT	Initial Production Tests
IPT	Integrated Product Team
IR	Infrared
IRT^3	Infrared Targets For Testing and Training
ISAQ	Interim Statement of Aircraft Qualification
ISAR	Inverse Synthetic Aperture Radar
ISP	Interim System Production
ISR	Intelligence, Surveillance, and Reconnaissance
ISTF	Installed System Test Facility
ITAS	Improved Tow Acquisition System
ITO/TMO	Installation Transportation Office/Transportation Management Office
ITT	International Telephone and Telegraph
ITT	Integrated Test Team
ITV	Intransit Visibility
ITW/AA	Integrated Tactical Warning and Attack Assessment
IUS	Inertial Upper Stage
IUSS	Integrated Undersea Surveillance System
IV&V	Independent Verification and Validation
IWSDB	Integrated Weapon System Data Base
JAAM	Joint Anti-Air Model
JACADS	Johnston Atoll Chemical Agent Disposal System
JADS	Joint Advanced Distributed Simulation
JAMC	Joint Amphibious Mine Countermeasures
JAOC	Joint Air Operations Center
JASSM	Joint Air-To-Surface Standoff Missile
JAST	Joint Advanced Strike Technology
JBPDS	Joint Biological Point Detection System
JBREWS	Joint Biological Remote Early Warning System
JCAD	Joint Chemical Agent Detector
JCALS	Joint Computer-Aided Acquisition and Logistics Support
JCAS	Joint Close Air Support
JCM	Joint Countermine
JCMD	Joint Cruise Missile Defense
JCOS	Joint Countermine Operational Simulation
JCS	Joint Chiefs of Staff
JCSAR	Joint Combat Search and Rescue

JDAM	Joint Direct Attack Missile
JDAMs	Joint Direct Attack Munitions
JDT/OT	Joint Development Test/Operational Test
JECSIM	Joint Electronic Combat Test Using Simulation
JET	Joint Estimating Team
JFCOM	Joint Forces Command
JFS	Joint Feasibility Study
JHMCS	Joint Helmet Mounted Cueing System
JIM	Joint Improvement and Modernization
JIMIS	JSTARS Integrated Maintenance Information System
JITC	Joint Interoperability Test Command
JITC	Joint Interoperability Test Command
JLENS	Joint Land Attack Cruise Missile Defense Elevated Netted Sensor System
JLF	Joint Live Fire
JMASS	Joint Model and Simulation System
JMCIS	Joint Maritime Command Information System
JMEM	Joint Munitions Effectiveness Manual
JMPS	Joint Mission Planning Segment
JMVX	Joint Multi-Mission Vertical Lift Aircraft
JPATS	Joint Primary Aircraft Training System
JPF	Joint Programmable Fuze
JPIAS	Joint Product and Information Access System
JPRA	Joint Personnel Recovery Agency
JREX	Joint Rescue Exercise
JRMET	Joint Reliability, Maintainability, and Evaluation Team
JROC	Joint Requirements Oversight Council
JRTC	Joint Readiness Training Center
JSC	Joint Spectrum Center
JSEAD	Joint Suppression Of Enemy Air Defenses
JSF	Joint Strike Fighter
JSHIP	Joint Shipboard Helicopter Integration Process
JSIPS	Joint Service Imagery Processing System
JSLNBCRS	Joint Services Light Nuclear, Biological and Chemical Reconnaissance System
JSLSCAD	Joint Services Lightweight Standoff Chemical Agent Detector
JSOW	Joint Standoff Weapon
JSTARS	Joint Surveillance Target Attack Radar System

JT&E	Joint Test and Evaluation
JTA	Joint Tactical Architecture
JTCG/AS	Joint Technical Coordinating Group on Aircraft Survivability
JTCG/ME	Joint Technical Coordinating Group for Munitions Effectiveness
JTD	Joint Test Director
JTD	Joint Theater Distribution
JTD JT&E	Joint Theater Distribution Joint Test and Evaluation
JTF	Joint Test Force
JTFEX	Joint Task Force Exercise
JTIDS	Joint Tactical Information Distribution System
JTMD	Joint Theater Missile Defense
JTRS	Joint Tactical Radio System
JTUAV	Joint Tactical UAV
JV	Joint Vision
JWARN	Joint Warning and Reporting Network
JWARS	Joint Warfare System
JWF	Joint Warfighters
JWG	Joint Work Group
JWID-97	Joint Warfighter Interoperability Demonstrations
kbps	Kilobits Per Second
KEM	Kinetic Energy Missiles
KMR	Kwajalein Missile Range
L/V	Lethality/Vulnerability
LA	Lead Agents
LACMD	Land Attack Cruise Missile Defense
LADS	Low Altitude Demonstrations System
LAMPS	Light Airborne Multi-Purpose System
LAN	Local Area Network
LAR	Launch Acceptability Region
LBT	Low Band Transmitter
LCAC	Landing Craft Air Cushion
LCC	Launch Control Center
LCOM	Logistics Composite Model
LDR	Low Data Rate
LEAP	Light Exoatmospheric Projectile
LEO	Low Earth Orbit

LF	Launch Facilities
LFA	Low Frequency Active
LFT	Legacy Field Test
LFT&E	Live Fire Test and Evaluation
LFT&T	Live Fire Test and Training
LH	Long-Haul
LHT	Lightweight Hybrid Torpedo
LIVEX	Live-Fly Exercises
LMTV	Light-Medium Tactical Vehicles
LO	Low Observability
LO/LO	Lift On/Lift Off
LOBL-I	Lock-On Before Launch Inhibit
LOSAT	Line-Of-Sight Antitank Missile
LOS-R	Line-Of-Sight-Rear
LOTS	Logistics-Over-the-Shore
LPU	Limited Procurement Urgent
LRE	Launch and Recovery Element
LRIP	Low Rate Initial Production
LRIP 1	Least One Production Pod
LSCFT	Low-Speed Captive Flight Tests
LST	Legacy Simulation Test
LUT	Limited User Test
M&S	Modeling and Simulation
M^3P	Multi-Mission Mobile Processors
MAGTF	Marine Air-Ground Task Force
MAISRC	Major Automated Information Systems Review Council
MAMC	Madigan Army Medical Center
MAMS	Military Airspace Management System
MANPADS	Man-Portable Defense Systems
MAP	Mission Assessment Process
MARCOT	Maritime Combined Operations Training
MASCAL	Mass Casualty
MASS	Military Aircraft Sustainability Simulation
MAST	Milstar Advanced Satellite Terminal
MC	Mission Capable
MCE	Mission Control Element

MCM	Mine Countermeasures Ships
MCOTEA	Marine Corps Operational Test and Evaluation Agency
MCP	Managed Care Program
MCS	Mission Computer System
MCS	Maneuver Control System
MCSB	MCS Backup
MCTFS	Marine Corps Total Force System
MCU	Mission Computer Upgrade
MD	Mission Data
MDA	Milestone Decision Authority
MDAP	Major Defense Acquisition Program
MDR	Medium Data Rate
MDSS II	Deployment Support System II
MEADS	Medium Extended Air Defense System
MECA	Medical Electronic Customer Assistance
MEFP	Multiple-Fragment, Explosively Formed Penetrator
MEVA	Modular Effectiveness Vulnerability Assessment
MEWSS	Marine Mobile Electronic Warfare Support System
MFD	Multifunction Display
MFOM	MLRS Family Of Munitions
MFTA	Multi-Function Towed Array
MGSM	Medium Ground Station Module
MHC	Coastal Mine Hunter
MHE	Material Handling Equipment
MHSS	Military Health Services system
MICM	Magnetic Influence Countermeasure
MICOM	Missile Command
MIDS	Multifunction Information Distribution System
MIDSCO	Mids Consortium
MIDS-FDL	Mids Fighter Data Link
MIDS-LVT	Multifunction Information Distribution System Low Volume Terminal
MIES	Modernized Imagery Exploitation System
Mil Std	Military Standard
MILCON	Military Construction
MILDEP	Military Department
MILSPEC	Military Specification

Mini-DAMA	Miniaturized Demand Assigned Multiple Access
MISSI	Multilevel Information System Security Initiative
MIT/LL	MIT Lincoln Laboratory
MITL	Man-In-The-Loop
MLC	Military Load Class
MLRS	Multiple Launch Rocket System
MMF	Mobile Maintenance Facility
MMLS	Mobile Microwave Landing System
MMR	Multi-Mode Radar
MNS	Mine Neutralization System
MOE	Measures of Effectiveness
MOP	Measures Of Performance
MOT&E	Multi-Service Operational Test and Evaluation
MOU	Memorandum of Understanding
MPM	Mission Planning Module
MPS	Mission Planning System
MR	Medium Range
MRF	Multi-Role Fighter
MRTFB	Major Range and Test Facility Base
MS	Milestone
MSE	Mobile Subscriber Equipment
MSO	Mine Sweepers
MS-OT	Multi-Service Operational Testing
MSRC	Major Shared Resource Center
MSS	Mission Support Segment
MSTE	Multi-Spectral Threat Environment
MSTRAP	Multi-Sensor Torpedo Recognition and Alertment Processor
MT	Mini-Test
MTBCF	Mean Time Between Critical Failures
MTBEFF	Mean Time Between Essential Function Failure
MTBOMF	Mean Time Between Operational Mission Failure
MTF	Medical Treatment Facility
MTI	Moving Target Indicator
MTT	Multi-Service Test Team
MTV	Medium Tactical Vehicles
MUA	Military Utility Assessment

MUOS	Mobile User Objective System
MUSE	Multiple UAV Simulation Environment
MVS	Multiple Virtual Storage
MWSS	Missile Warning Sensor Simulator
NAD	Navy Area Defense
NALCOMIS	Naval Aviation Logistics Command Information System
NAMEADSMA	NATO MEADS Management Agency
NASA	National Aeronautics and Space Administration
NATBMD	Navy Area Theater Ballistic Missile Defense
NATO	North Atlantic Treaty Organization
NAVORDSTA	Naval Ordnance Station
NAWC	Naval Air Warfare Center
NAWCAD	Naval Air Warfare Center-Aircraft Division
NAWCWD	Naval Air Warfare Center – Weapons Division
NBCRS	Nuclear, Biological, and Chemical Reconnaissance System
NCA	National Command Authority
NCS	Net Control Station
NCTS	Navy Computer and Telecommunications Station
NCTS-W	Navy Computer and Telecommunications Station-Washington
NCW	Network Centric Warfare
NDI	Non-Developmental Item
NECA	Newport Chemical Activity
NESP	Navy Extra-High Frequency Satellite Program
NIMA	National Imagery and Mapping Agency
NMCC	National Military Command Center
NMD	National Missile Defense
NMM	National Mission Model
NOAA	National Oceanic and Atmospheric Administration
NOC	Network Operating Center
NORAD	North American Air Defense Command
NPOESS	National Polar-Orbiting Operational Environmental Satellite System
NRWATS	Naval Rotary Wing Aircraft Test Squadron
NSCMP	Non-Stockpile Chemical Materiel Project
NSIPS	Navy Standard Integrated Personnel System
NSSN	New Attack Submarine
NSWC-DD	Naval Surface Warfare Center-Dahlgren Division

NTCS-A	Naval Tactical Command System -Afloat
NTCSS	Naval Tactical Command Support System
NTDS	Naval Tactical Data System
NTTR	Nevada Test and Training Range
NUWCNPT	Naval Undersea Warfare Center, Newport, Ri
OA	Operational Assessment
OASD(HA)	Office of the Assistant Secretary of Defense (Health Affairs)
OASD/C^3I	Office of the Assistant Secretary of Defense for Command, Control, Communications, and Intelligence
OASYS	Obstacle Avoidance System
OBIGGS	On-Board Inert Gas Generating System
OBS	Onboard System
OCAP	Operational Capability Assessment Process
OCU	Operator Control Unit
OCV	Operational Concept Validation
ODOT&E	Office of Director, Operational Test and Evaluation
OEC	Operational Evaluation Command
OFP	Operational Flight Program
OFP	Operational Flight Profile
OICW	Objective Individual Combat Weapon
ONS	Operational Needs Statement
OPEVAL	Operational Evaluation
OPTEC	Operational Test and Evaluation Command
OPTEVFOR	Operational Test and Evaluation Force
OR	Operational Requirement
ORD	Operational Requirements Document
ORSMC	Off Route Smart Mine Clearance
OS	Operational Experiment
OT	Operational Testing
OT&E	Operational Test and Evaluation
OTA	Operational Test Agency
OTP	Operational Test Plan
OUSD P&R	Office Of The Under Secretary Of Defense For Personnel and Readiness
OVT	Operational Verification Test
P3I	Pre-Planned Product Improvements
PAC-3	Patriot Advanced Capability-3

PACOM	Pacific Command
PAR	Precision Approach Radar
PAS	Processing and Analysis Segment
PCO	Prospective Commanding Officer
PCT	Longbow Hellfire Production Confidence Test
PD&RR	Program Demonstration and Risk Reduction
PD/V	Program Definition and Validation
PD^2	Procurement Desktop-Defense
PDA	Power Distribution Assembly
PDB	Post-Deployment Build
PDRR	Preliminary Design and Risk Reduction
PDRR	Program Definition and Risk Reduction
PE	Program Element
PEO	Program Executive Officer
PEO-T	Navy Program Executive Officer-Tactical Aircraft
PEP	Producibility Enhancement Program
PERS	Player Event Reconstruction System
PFA	Personnel Formation Airdrop
PFM	Pre-Flight Message
PFPS	Portable Flight Planning Software
PGMs	Precision-Guided Munitions
PI	Product Improvement
PID	Positive Identification Program
PINES	Pacific Air Forces Integrated National Exploitation System
PIP	Product Improvement Program
P_k	Probability of Kill
PLRS	Position Location Reporting System
PLS	Palletized Load System
PLSAG	Precision Landing Study Advisory Group
PM	Program Manager
PMCD	Polychlorinated Biphenyl Problem
PMO	Program Management Office
PMRF	Pacific Missile Range Facility
POM	Program Objective Memorandum
POP	Proofs of Principle
POSNAV	Position Location and Navigation

PPI	Personnel Process Improvement
PPQT	Pre-production Qualification Testing
PPT	Production Prove-Out Test
PPVs	Pre-Production Vehicles
PPVT and PQT	Pre-Production Verification/Production Qualification Testing
PQT	Production Qualification Test
Pre-MDAP	Pre-Major Defense Acquisition Program
PRP	Propulsion Replacement Program
PRTV	Production representative Test Vehicles
PtSi	Platinum Silicide
PTW	Precision Targeting Workstation
PVT	Performance Verification Test
PVT	Product Verification Testing
QM	Qualification Motors
QOT&E	Qualification Operational Test and Evaluation
QRC	Quick Reaction Capability
QT&E	Qualification Test and Evaluation
R&D	Research and Development
R/P	Receiver/Processor
RAM	Rolling Airframe Missile
RAM	Reliability, Availability, and Maintainability
RCAS	Reserve Component Automation System
RDBMS	Relational Database Management System
RDT&E	Research, Development, Test, and Evaluation
RECBASS	Reception Battalion Automated Support System
REP	Resource Enhancement Project
RERP	Reliability Enhancement and Re-Engineering Program
RF	Radio Frequency
RF/IR	Radio Frequency/Infrared
RFCM	Radio Frequency Countermeasures
RFPI	Rapid Force Projection Initiative
RM&A	Reliability, Maintainability and Availability
RMP	Reprogrammable Microprocessor
RN	Royal Navy
RO/RO	Roll-On/Roll-Off

ROC	Required Operational Capability
ROS	Relief On Station
RRDF	RO/RO Discharge Facility
RSA	Range Standardization and Automation
RSC	Regional Service Center
RSIP	Radar System Improvement Program
RSTA	Reconnaissance, Surveillance, and Target Acquisition
RSTARS [MP]	Reserve Standard Training, Administration, and Readiness Support [Manpower and Personnel]
RSV	Resupply Vehicle
RTIC	Real-Time Information Into The Cockpit
RUG	Radar Upgrade
RWR	Radar Warning Receiver
RWS	Remote Workstation
S&T	Science and Technology
SAC	Senior Advisory Council
SADS	Submarine Antenna Distribution System
SAE	Service Acquisition Executive
SAG	Surface Action Group
SAG	Senior Advisory Group
SAL	Semi-Active Laser
SAM	Surface-to-Air Missile
SAR	Synthetic Aperture Radar
SAST	Small Arms Simulator Testbed
SAT	System Acceptance Testing
SATCOM	Satellite Communications
SAW	Squad Automatic Weapon
SBA	Strategic Brigade Airdrop
SBIRS	Space-Based Infrared System
SBL	Space Based Laser
SBS	Submarine Baseband Switch
SBU	Sensitive But Unclassified
SC 21	Twenty-First Century Combatant
SCAMP	Single-Channel Anti-Jam Man-Portable
SCIS	Survivable Communications Integration System
SCSS	Submarine Communications Support System

SDS	Source Data Systems
SDS	Surveillance Direction System
SDT	Software Development Testing
SDTS	Self Defense Test Ship
SEAD	Suppression Of Enemy Air Defenses
SELF	Synthetic Environment Live Fire
SEP	System Evaluation Plan
SEP	Soldier Enhancement Program
SEP	System Enhancement Package
SEWG	System Effectiveness Working Group
SFW	Sensor Fuzzed Weapon
SHF	Super-High Frequency
SIDPERS-3	Standard Installation/Division Personnel System Version 3
SIGINT/EW	Signal Intelligence/Electronic Warfare
SIL	System Integration Laboratory
SIMAS II	Sonar In-Situ Mode Assessment System
SINCGARS	Single Channel Ground and Airborne Radio System
SIOP	Single Integrated Operational Plan
SIP	System Improvement Program
SIP	System Improvement Phase
SIPRNET	Secret Internet Protocol Router Network
SIRFC	Suite of Radio Frequency Countermeasures
SLAM	Stand-Off Land Attack Missile
SLAM-ER+	Stand-Off Land Attack Missile-Expanded Response Plus
S-LAN	Signal LAN
SLEP	Service Life Extension Program
SLFE	System-Level Formative Evaluation
SLVR	Submarine LF/VLF VME Bus Receiver
SM-3	Standard Missile-3
SMART-T	Secure Mobile Antijam Reliable Tactical-Terminal
SMCS	Survivable MCS
SMIC	Strategic Missile Integration Complex
SNAP	Shipboar Non-Tactical ADP Program
SOA	Special Operations Aircraft
SOCCOM	Special Operations Command
SOF	Special Operations Forces

SOF	Safety Of Flight
SOP	Standard Operating Procedures
SOR	System of Record
SOSC	System Operational and Support Capability
SOSUS	Sound Ocean Surveillance System
SPBS-R	Standard Property Book System - Revised
SPH	Self-Propelled Howitzer
SPO	System Program Office
SPS	Standard Procurement System
SQT	Software Qualification Testing
SRALT	Short-Range Air Launched Target
SRM	Solid Rocket Motors
SRMU	Solid Rocket Motor Upgrade
SRO	September Research Operations
SROC	Senior Readiness Oversight Council
SRWG	Sustainable Ranges Working Group
SS	Single Source
SSAI	Safety and Survivability of Aircraft Initiative
SSDS	Ship Self Defense System
SSFE	Source Selection Flight Evaluation
SSIPS	Shore Signal Information Processing Segment
SSP	Strategic Sealift Program
SSPA	Solid State Power Amplifier
ST	Stimulation Test
STAMIS	Standard Army Management Information Systems
STARS	Standard Accounting and Reporting System
STOVL	Short Takeoff and Vertical Landing
STOW	Synthetic Theater of War
STR	Software Trouble Reports
STRICOM	Service Training and Simulation Commands
STW	Strike Warfare
SUA	Special-Use Airspace
Sub-ATWCS	Submarine Advanced Tomahawk Weapons Control System
SubECS	Submarine Exterior Communications System
SURTASS	Surveillance Towed Array Sensor System
SURVIAC	Survivability/Vulnerability Information Analysis Center

SVML	Standard Vehicle Mounted Launcher
SWAN	Ship-Wide Area Network
SWAT	Shallow Water ASW Target
SWATH	Small Water-Plane Area Twin Hull
SWPS	Strategic War Planning System
SWV	Software Versions
T&E	Test and Evaluation
T&M	Test and Measurement
T/FSDS	Time/Frequency Standard Distribution System
T-45TS	T-45 Training System
TAC	Tactical Command Post
TACAMO	Take Charge and Move Out
TACAN	Tactical Air Navigation
TACCSF	Theater Air Command and Control Simulation Facility
TACMS	Tactical Missile System
TADIL J	Through Adoption Of Link-16
TAG	Technical Advisory Group
TAMPS	Tactical Aircraft Mission Planning System
TAMPS	Tactical Automated Mission Planning System
TAP	Test and Analysis Plan
TAPDB	Total Army Personnel Data Base
TAPS	Tactical Aircraft Planning System
TAS	Target Acquisition System
TBIP	Tomahawk Baseline Improvement Program
TBJ	Terrain Bounce Jamming
TBM	Tactical Ballistic Missiles
TBMs	Theater Ballistic Missiles
TCACCIS	Transportation Coordinator Automated Command and Control Information System
TCAIMS	Transportation Coordinator Automated Information Management System
TCG	Track Control Group
TCS	Tactical Control System
TDMA	Time Division Multiple Access
TDSS	Tactical Decision Support Subsystem
TEG	Tactical Exploitation Group
TEMP	Test and Evaluation Master Plan

TERPES	Tactical Electronic Reconnaissance Processing and Evaluation System
TEWS	F-15 Tactical Electronic Warfare System
TEXCOM	Test and Experimentation Command
TF/TA	Terrain Following/Terrain Avoidance
THAAD	Theater High-Altitude Air Defense
TI	Tactical Internet
TILV	Target Interaction Lethality Vulnerability
TIMS	Training Integration Management System
TJS	Tactical Jamming System
TLAM-C	Tomahawk Conventional Land Attack
TLAM-D	Tomahawk Conventional Land Attack Submunition
TLAM-N	Nuclear Land Attack Not Deployed
TLE	Target Location Errors
TM	Telemetry
TM	Technical Manual
TMD	Tactical Munitions Dispenser
TMD	Theater Missile Defense's
TMIP	Theater Medical Information Program
TMPC	Theater Mission Planning Center
TMSS	Total Mine Simulation System
TOCDF	Tooele Chemical Disposal Facility
TOCs	Tactical Operations Center's
TOW	Tube-Launched, Optically-Tracked, Wire-Guided
TPU	Torpedo Propulsion Upgrade
TPWG	Test and Evaluation Planning Working Group
TRAC2ES	Transcom Regulating and Command & Control Evacuation System
TRACS.	Transportable Range Augmentation And Control System
TRADOC	Army Training and Doctrine Command
TRAFS	Torpedo Recognition and Alertment Functional Segment
TRICARE	Tri-Service Health Care
TRTC	Tropic Regions Test Center
TS^3	Top Secret Support System
TSO	Threat Systems Office
TSSAM	Tri-Service Stand-Off Attack Missile Program
TSST	Total Ship Survivability Trial
TTD&D	Test Technology Development and Demonstration

TTP	Tactics, Techniques and Procedures
TUAV	Tactical Unmanned Aerial Vehicle
TVC	Thrust Vector Control
TWCS	Tomahawk Weapon Control System
TWS	Tomahawk Weapon System
UAAPV	Under Armor Auxiliary Power Unit
UAV	Unmanned Aerial Vehicle
UBS	UHF Base Stations
UCP-99	1999 Unified Command Plan
UDF	User Data File
UEU	Universal Exciter Upgrade
UFCS	Underwater Fire Control System
UFL-97	Ulchi Focus Lens-97
UFO	Ultra-High Frequency Follow On
UFP	Unit Flyaway Price
UHF	Ultra-High Frequency
UK	United Kingdom
ULLS	Unit Level Logistics System
UMIDS	Uniform Microcomputer Disbursing System
UNDEX	Underwater Explosion
USAFAWC	United States Air Force Air Warfare Center
USD(A&T)	Under Secretary of Defense (Acquisition & Technology)
USD(A,T&L)	Undersecretary of Defense for Acquisition Technology and Logistics
USEUCOM	US European Command
USFK	U.S. Forces-Korea
USNS	United States Naval Ship
USSOCOM	U.S. Special Operations Command
USTRANSCOM	United States Transportation Command
UTTR	Utah Test and Training Range
UWS	Underwater Segment
V&V	Verification and Validation
VAFB	Vandenberg Air Force Base
VAR	Vulnerability Assessment Report
VCD	Verification Of Correction To Deficiencies
VCS	Vapor Cooling System
VCSS	Voice Communications Switching System

VECP	Value Engineering Change Proposal
VHF	Very High Frequency
VHSIC	Very High Speed Integrated Circuit
VITAR	Virtual Target and Range
VLA	Vertical Launch ASROC
VLF	Very Low Frequency
VLS	Vertical Launching System
VLSE	Vulnerability Lethality Simulation Enhancements
VM/ESA	Virtual Machine/ESA
VMS	Vertical Motion Simulator
VPE	Virtual Prototype Experiment
VSTOL	Vertical/Short Takeoff and Landing
VSWE	Virtual Strike Warfare Environment
WAA	Wide Aperture Array
WAF	Weapons Analysis Facility
WAM	Wide Area Munition
WCMD	Wind Corrected Munitions Dispenser
WGS	Wideband Gapfiller Satellite
WIPT	Working IPT
WJHTC	William J. Hughes Technical Center
WMD	Weapons of Mass Destruction
WRA/LRU	Weapons Replaceable Assembly/Line Replaceable Unit
WRA-V	Weapon Replaceable Assembly
WSMR	White Sands Missile Range
WST	Warhead Sled Test
WTR	Western Test Range
WWMCCS	World Wide Military Command and Control System
YPG	Yuma Proving Ground

INDEX OF PROGRAMS

INDEX OF PROGRAMS

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