FY 2012 Annual Report

Since my confirmation as Director of Operational Test and Evaluation (DOT&E) in 2009, I have implemented initiatives to improve the quality of test and evaluation (T&E) within the Department of Defense. I have emphasized early engagement of testers in the requirements process, improving system suitability by designing reliability into systems from the outset, and integrating developmental, operational, and live fire testing. Implementing these initiatives has revealed the need for an additional area of focus – the requirement to incorporate statistical rigor in planning, executing, and evaluating the results of testing.

There are significant opportunities to improve the efficiency and the outcomes of testing by increasing interactions between the testing and requirements communities. In particular, there should be early focus on the development of operationally relevant, technically feasible, and testable requirements. In this Introduction, I discuss the crucial role the T&E community can and should play as requirements are developed. Additionally, I describe DOT&E efforts to institutionalize the use of statistical rigor as part of determining requirements and in T&E. I also provide an update on the Department's efforts to implement reliability growth planning and improve the reliability and overall suitability of our weapon systems. And lastly, I describe challenges and new developments in the area of software T&E.

Last year, I added a new section to my Annual Report assessing systems under my oversight in 2010 – 2011 with regard to problem discovery during testing. My assessment fell into two categories: systems with significant issues observed in operational testing that should, in my view, have been discovered and resolved prior to the commencement of operational testing, and systems with significant issues observed during early testing that, if not corrected, could adversely affect my evaluation of those systems' effectiveness, suitability, and survivability during Initial Operational Test and Evaluation (IOT&E). This year, I am providing an update to the status of those systems identified last year, as well as my assessment of systems under my oversight in 2012 within those two categories.

THE ROLE OF T&E IN REQUIREMENTS

There is an inherent and necessary link between the requirements and the test communities. The requirements community must state our fighting force's needs in the form of concrete, discrete capabilities or *requirements*. The testing community must then assess a system that is developed and produced to meet those requirements to determine whether it provides the military capability being sought; that is, we evaluate the system's operational effectiveness and suitability when used by our forces in combat. In my opinion, the collaboration needed between the requirements and the test communities to discharge these responsibilities needs to be strengthened.

In my report last year, I discussed the Defense Acquisition Executive (DAE) independent assessment of concerns that the Department's developmental and operational test communities' approach to testing drives undue requirements, excessive cost, and added schedule into programs. The DAE assessment team "found no significant evidence that the testing community typically drives unplanned requirements, cost, or schedule into programs." However, they did note that there were four specific areas that needed attention:

> *"The need for closer coordination and cooperation among the requirements, acquisition, and testing communities; the need for well-defined testable requirements; the alignment of acquisition strategies and test plans; and the need to manage the tension between the communities."*

The lack of critically needed collaboration among the technical, test, and requirements communities is not new. The 1986 Packard Commission found that success in new programs depends on "an informed trade-off between user requirements, on one hand, and schedule and cost, on the other." It therefore recommended creation of a new body representing both military users and acquisition/technology experts. This ultimately led to the creation of the Joint Requirements Oversight Council (JROC), which includes the military operators as formal members but includes, as advisors only, the acquisition and test communities. In 1998, the National Research Council (NRC) identified the need for greater interaction between the test and the requirements communities; the NRC pointed out that operational test personnel should be included in the requirements process in order to assist in establishing "verifiable, quantifiable, and meaningful operational requirements." And the National Defense Authorization Act for FY11 specifically named DOT&E as an advisor to the JROC. However, obstacles for close collaboration remain. I discuss below three specific areas where increased interactions could result in improved test outcomes, which should then result in systems with needed and useful combat capability being delivered to our forces more quickly.

Mission-Oriented Metrics

OT&E is defined in Title 10 United States Code as:

> *"The field test, under realistic combat conditions, of any item of (or key component of) weapons, equipment, or munitions for use in combat by typical military users; and the evaluation of the results of such tests."*

Weapon systems sit in the motor pool, at the pier, or on the runway. Individual systems do not have missions; it takes Soldiers, Sailors, Airmen, and Marines to make them work. Operational testing is about assessing mission accomplishment of the unit equipped with a system. To evaluate operational effectiveness we seek to answer the question, "can a unit equipped with the system accomplish the mission?" Operational effectiveness is defined in the Joint Capabilities Integration and Development System (JCIDS) manual as:

> *"Measure of the overall ability of a system to accomplish a mission when used by representative personnel in the environment planned or expected for operational employment of the system considering organization, doctrine, tactics, supportability, survivability, vulnerability, and threat."*

And the Defense Acquisition Guide emphasizes "the evaluation of operational effectiveness is linked to mission accomplishment." End-to-end testing with operational users across the intended operational envelope is essential to assessing the system's impact on mission accomplishment. Additionally, each system must be evaluated within the context of the system-of-systems within which it will operate.

In January 2010, I provided guidance to the Operational Test Agencies on the reporting of OT&E results reiterating that the appropriate environment for any operational evaluation includes the system being tested and all interrelated systems needed to accomplish an end-to-end mission in combat. I emphasized that the primary purpose of OT&E is to describe the operational effectiveness and suitability of the system being tested within that environment. A subsidiary purpose of OT&E, stated in DoDI 5000.02, is to determine if thresholds in the approved Capability Production Document (CPD) have been satisfied. The measures used for this purpose are appropriately referred to in the context of "performance" as in "key performance parameters (KPPs)," or "measures of performance." But these measures associated strictly with evaluating KPPs are not the full set necessary to evaluate operational effectiveness in combat.

Requirements are often stated in terms of technical parameters whose satisfaction is necessary, but not sufficient to determine a system's effectiveness, suitability, and survivability when used in combat. Ideally, KPPs should provide a measure of mission accomplishment, lend themselves to good test design, and encapsulate the reasons for procuring the system. However, DOT&E has seen many examples of KPPs that are not informative to an evaluation of mission accomplishment. For example, a previous ground combat vehicle had KPPs that only required it seat nine passengers, be transportable by a C-130, and have a specific radio system; these requirements could have been met by a passenger van. Another example was an amphibious ship with KPPs for the number of helicopter spots, the number of storage spaces, and the maximum speed of the ship; these requirements could have been measured with a stopwatch and a tape measure and could have been satisfied by a commercial ship with no capability to survive amphibious combat. While these technical performance requirements are important, they are not sufficient to determine whether the ground vehicle or ship can be used successfully in combat. In these cases, the test community encouraged the use of metrics for evaluation directly tied to mission success such as accomplishing geographic objectives while minimizing blue force losses or meeting an aircraft sortie generation rate and surviving likely attacks. If the test and requirements communities engage early, requirements can be stated in a manner that makes them directly relevant to mission success and therefore, both directly relevant to operational testing and much more capable than technically-oriented parameters of informing whether the sought-for combat capabilities have been achieved in the system to be produced.

Leveraging T&E Knowledge in Setting Requirements

Interactions between the requirements writers and the testers can also help identify alternatives to hard-to-test or impossible-to-test requirements. Requirements that cannot be verified in testing may as well not exist. The T&E community can help identify unrealistic, unaffordable, and un-testable requirements. Additionally, T&E knowledge of the current threat environment and test infrastructure can help the requirements community understand what resources will be needed to test a given requirement. We have seen Service requirements officers state they want demanding if not technically unachievable requirements to drive vendors to deliver the best possible system performance; but, history has shown setting very high or unachievable requirements is particularly destructive to program success. For example, the Future Combat System program required high survivability ("tank-like") and tactical transportability (via C-130) that, together, were impossible to achieve. Additionally, reliability requirements for that system were much higher – nearly 10 times – that of our current systems, making achievement of those requirements both unrealistic and unaffordable. Clearly, we should not eliminate requirements simply because they are difficult to test. We must, however, carefully consider whether difficulty (or impossibility) of testing requirements implies the same for their achievement.

Testers have experience with the difficulty and cost associated with the testing needed to demonstrate whether certain metrics have been achieved. For example, consider a requirement for 99 percent reliability for completing a 6-hour mission. This is comparable to 600 hours between failures and would require at a minimum 1,800 hours of testing to verify. However, if the requirement were 95 percent reliability for completing the same 6-hour mission, the associated mean time between failures is only 120 hours and testing to that requirement could be accomplished in a minimum of 360 hours. If the testing revealed 40 hours between failures (instead of 120 or 600) that would indicate an 86 percent probability of completing a 6-hour mission. Would 95 percent or 86 percent be good enough? To answer that question, the rationale, or so-what factor, for the requirement should be fully explained. Accordingly, I intend to require that Test and Evaluation Master Plans (TEMPs) have an annex explaining the user's rationale for the requirements contained in the Capability Development Document. The requirements and their associated rationale should be revisited as often as needed as a program proceeds and knowledge is gained regarding the ability to achieve the program's currently stated requirements.

In addition to the value selected for a requirement, the manner in which a requirement is stated can also make testing expensive or impractical. For example, metrics stated as binomial probabilities (99 percent probability of detecting a target) are expensive to test because they require large sample sizes to gain statistical confidence in the results. Metrics that are physical, continuous, easily measured, and operationally meaningful can be used instead of such probabilities. For example, the "median miss distance" can be measured at high confidence with about a third the number of tests as the "probability of hit," and also provides more information from the resulting distribution of measurements (how close or far away) than a simple hit/miss answer. In many instances, the probabilities now often used to state requirements can be subsequently estimated using test data collected to evaluate continuous response metrics. Thus, wherever possible, I am requiring test plans that measure continuous performance variables as the basis for evaluating thresholds for requirements that have been written in terms of probabilities.

Evaluation Across the Operational Envelope

Another disconnect among the requirements, test, and operational communities is that often requirements are narrowly-focused and do not cover the operational envelope; a notional depiction is shown in Figure 1. To be adequate, the operational evaluation must report performance of the system across the operational envelope, not just at single conditions specified in the capabilities documents. There is a common concern that failing to specify a certain, limited set of conditions within requirements could lead to an unwieldy test. This is a key reason DOT&E is using Design of Experiments (DOE) to plan testing that efficiently spans the operational envelope. Requirements would be much more useful and meaningful if they identify multiple conditions in which the system is likely to be operated.

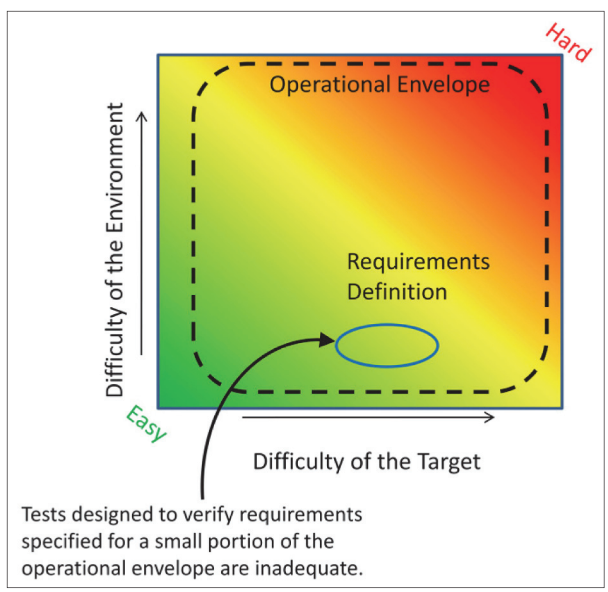

FIGURE 1. NOTIONAL TWO-DIMENSIONAL DIAGRAM OF A WEAPON SYSTEM'S OPERATIONAL ENVELOPE

I will continue to advocate for and require the use of DOE to plan and execute tests that span the operational envelope. One of the key tenets of a well-designed experiment is that all stakeholders must be engaged in the determination of the goals, metrics, operational envelope, and test risks. The requirements community is a key stakeholder that can provide valuable input regarding what the key factors (or conditions) are that will most influence mission performance and thus should be considered in operational test.

In summary, through early and continuous engagement between the testing and requirements communities, we can craft requirements that are technically feasible, mission-oriented, realistic, testable, and responsive to the limitations and opportunities revealed during system development.

INCREASING STATISTICAL RIGOR OF T&E

In support of all of my initiatives, I have advocated for increasing the statistical rigor employed in planning and executing T&E. To that end, my office has recently completed a roadmap to institutionalize Test Science and statistical rigor in T&E. The roadmap was a collaborative activity among DOT&E, Deputy Assistant Secretary of Defense for Developmental Test and Evaluation (DASD(DT&E)), the Service Operational Test Agencies (OTAs), and the Service T&E Organizations.

By increasing statistical rigor and using state-of-the-art test and analysis methodologies, we will ensure defensible and efficient T&E. The Test Science Roadmap accomplishes the following:

- Assesses the current state of analytic capabilities within each of the Services and Office of the Secretary of Defense (OSD)
- Develops qualification guidelines for personnel performing test design and analytic services for different kinds of T&E organizations
- Identifies the training, education, and other support that Services and agencies will need to attain the required test design and analytic capabilities
- Develops case studies of the implementation of scientific test design across test programs
- Provides guidance for the documentation of test design and statistical rigor in TEMPs, test plans, and reports
- Forms a permanent Advisory Board to continually identify and advocate for the use of methods to incorporate statistical rigor in all test planning and execution

We have made significant progress in the past two years across all areas of the roadmap, as discussed below.

Education & Training

DASD(DT&E) is leading the way in improving the educational materials needed by our T&E community, and I strongly support them in this initiative. In the past year, we have added courses and content on statistical methods for T&E to courses offered by the Defense Acquisition University. We have also made training widely available across DOT&E, DASD(DT&E), and all of the Services.

Case Studies & Best Practices

Case studies are an essential educational tool illustrating the application of statistical methods, including DOE to T&E. Over the past couple of years, my office has developed and published many case studies demonstrating the usefulness of applying DOE and statistical methods to T&E. Additionally, in the roadmap meetings, each of the Services shared case studies highlighting the application of DOE to solve their Service-specific problems. DOT&E has compiled these case studies as a resource for the T&E community (https://extranet.dote.osd.mil). They highlight challenges, areas for further research, and best practices.

Guidance & Policy

Policy that supports the use of scientific test techniques is essential to ensuring a continued commitment to Test Science in years to come. Both DASD(DT&E) and DOT&E have supported including more detailed language in DoDI 5000.02 on increasing statistical rigor of T&E. DOT&E also published a TEMP guidebook highlighting the important content for TEMPs and test plans. This guidance is available on the DOT&E public website (www.dote.osd.mil). DASD(DT&E) has also taken the lead on incorporating Test Science topics into other guidance documents including the T&E Management Guide and the Guide on Incorporating T&E into DoD Acquisition Contracts. All of these resources provide clear and consistent guidance to the T&E community on the importance of statistics in T&E. DOT&E insists that TEMPs and test plans submitted for approval include substantive documentation of the application of DOE to test planning, execution, and evaluation.

Advisory Board

Two different advisory groups have been formed in the past two years. The first is the Science of Test Research Consortium, funded by DOT&E and the Director of Test Resource Management Center; this academic consortium provides technical advice to the DoD on Test Science issues. The second is the Scientific Test and Analysis Techniques (STAT) Center of Excellence (COE). The STAT COE funded by DASD(DT&E) is charged with assisting program managers of major acquisition programs. Together, these two groups are working to operationalize Test Science in active programs.

Future Efforts to Institutionalize Statistical Rigor

Notwithstanding the significant progress that has been made in the past two years, there is still work to be done to utilize the full toolset the scientific community has available to support T&E. I have seen the Service OTAs modify their test design and planning techniques to incorporate DOE and take advantage of the efficiencies afforded by the use of its

methods. Further, I have observed an improvement to the quality of the TEMPs and test plans that are based on these methods. However, there are two areas requiring improvement as the Department's institutionalizes statistical rigor in testing:
- Execution of testing in accordance with the planned test design
- Analysis of test data using the advanced statistical methods commensurate with test designs developed using DOE

For the former, I have seen some cases where a test is well-designed, but the desired conditions of the test in the field are not the same as required by the original plan. This has the effect of limiting the conclusions that can be made from the subsequent data or, at worst, wasting time and resources. Since most of our tests are focused on characterizing the performance of the system across the actual conditions in which the operators will employ the system, it is crucial that the planned conditions are achieved during the test.

For the second area, I have not yet observed all of the OTAs employing the data analysis methods that would reap the benefits of the efficiencies afforded by DOE. In other words, although the OTAs use statistical rigor in their test planning, they are not always following up with the same rigor in their analysis of test data. The simplest case of this is where a test is designed to cover all or many of the important operational conditions, and is optimized to be extremely efficient in the number of test iterations in each condition, but the data analysis is limited to reporting a single average (mean) of the performance across all the test conditions. This result throws away all of the careful test design efficiencies afforded by the use of DOE. A more statistically rigorous analysis would enable all the available information to be extracted from the data, which is critical to evaluating the performance of systems across their full range of operational use. The more advanced statistical analysis also enables statements of system performance to be made with higher confidence in many cases, so that acquisition decisions can be based on certain knowledge rather than supposition.

I will work with the Service OTAs during the next year to rectify these remaining shortfalls in the application of DOE to test execution and analysis.

RELIABILITY ANALYSIS, PLANNING, TRACKING, AND REPORTING

Improving system reliability has been a DOT&E initiative since 2006; the Department has also recognized the significant adverse long-term life cycle cost impacts and reduced operational capability resulting from systems being unreliable. DOT&E initiatives have emphasized the need for reliability growth planning and assessment, establishment of reliability maturity goals and entrance criteria for each phase of testing and documenting the reliability test and evaluation strategy (TES) in the TEMP. Accordingly, the Under Secretary of Defense for Acquisition, Technology, and Logistics (USD(AT&L)) in 2011 released a Directive Type Memorandum (DTM 11-03) on Reliability, Analysis, Planning, Tracking, and Reporting; this DTM was continued into 2012 and will be incorporated into the updated DoDI 5000.02 "Operation of the Defense Acquisition System."

I am tracking the impact of the new directive on system reliability. The Office of the Deputy Assistant Secretary of Defense for Systems Engineering (DASD(SE)) is developing an implementation guide, which is in final staffing and should be available in early 2013. DOT&E has been an ardent advocate for the reliability concepts contained in the directive, and has institutionalized them in our priorities and policies. Figure 2 plots the outcomes of initial operational tests reported to Congress for systems tested between fiscal years 1997 to 2012. A total of 118 reports were included; each report includes an evaluation of operational effectiveness, operational suitability, and reliability.

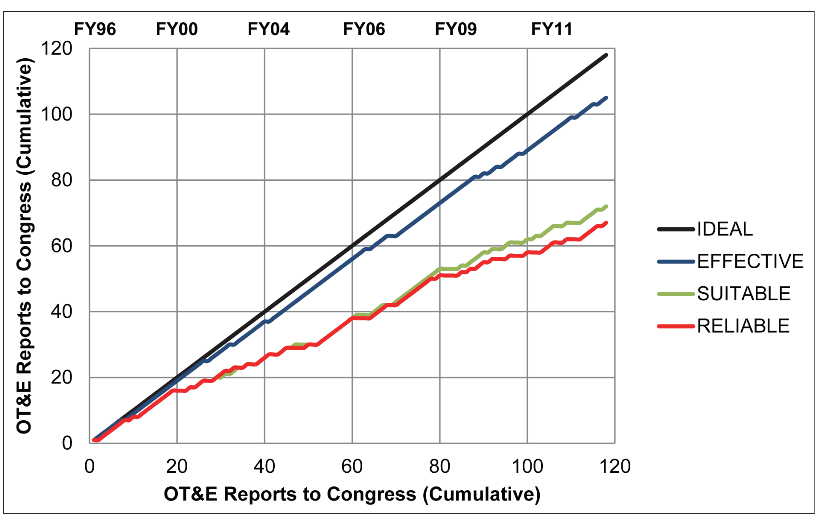

FIGURE 2. CURRENT TRENDS IN RELIABILITY

While evaluations of operational effectiveness and suitability are based on many factors, the evaluations displayed in this chart are based solely on whether the system met its required reliability threshold. As shown in Figure 2, reliability continues to lag; only 7/13 systems (54 percent) evaluated in 2012 met their reliability thresholds and overall between 1997 and 2012 only 67/118 systems (57 percent) were reliable.

To further understand the reliability trends in Figure 2, I surveyed 52 programs for which I approved TEMPs or TESs in FY11 following up on the survey I did in FY10 for all oversight programs. The TEMPs approved in FY11 continue the positive trends I am seeing for all TEMPs approved after June 2008 (when the Department began initiatives to improve reliability). These trends include programs:

- Having an approved System Engineering Plan
- Incorporating reliability as an element of the test strategy
- Having a reliability growth strategy and documenting it in the TEMP
- Incorporating reliability and availability requirements

Unfortunately, the programs reviewed in FY11 did not show improvement in establishing reliability-based milestone or operational test entrance and exit criteria. However, I believe the recent emphasis on reliability has had some demonstrable positive impacts. Having reliability growth curves alone did not correlate with attainment of reliability requirements, but programs with comprehensive reliability plans were more likely to meet their reliability requirements. A larger fraction of programs that establish growth curves with intermediate goals; anchor milestone or entrance/exit criteria to reliability performance; use metrics to ensure reliability growth is on track; predict changes caused by the implementation of corrective actions; and calculate reliability growth potential met their operational test reliability entrance and exit criteria compared to programs that do not follow these practices.

Examining the TEMP survey trends by Service shows that higher percentages of Army and Air Force programs: have added a reliability growth strategy since June 2008; have reliability growth curves; and are calculating the reliability growth potential. Army and Navy programs show increasing improvement in ensuring there is time in the schedule to implement and verify corrective actions and document the reliability test strategy. Army programs are most likely to: use reliability growth curves and intermediate reliability goals; put systems into the hands of representative users before Milestone C; and document reliability changes caused by implementation of corrective actions. Figure 3 shows the fraction of systems meeting reliability thresholds at IOT&E for programs on DOT&E oversight between 1997 and 2012 (the same programs depicted in Figure 2 now broken out by Service).

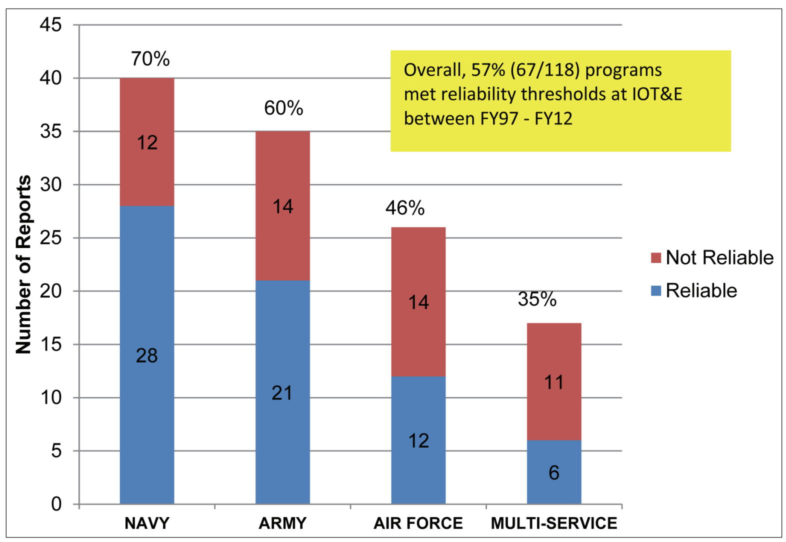

FIGURE 3. FRACTION OF PROGRAMS MEETING RELIABILITY THRESHOLDS AT IOT&E, BY SERVICE (FY97-FY12)

I am not yet seeing more systems actually meet their reliability requirements than in past years, but I believe the recent emphasis on reliability planning has had some demonstrable positive impacts. While the majority of programs now have and are documenting their reliability growth strategy in the TEMP, they are not fully incorporating the design for reliability tenets described in the ANSI/GEIA-STD-0009 Reliability Program Standard for Systems Design, Development, and Manufacturing. In particular, programs are failing to “get on” their planned reliability growth curve at the beginning. I have seen evidence that programs with a procedure for calculating reliability growth potential (a calculation that places emphases on initial reliability, which in turn requires that the system be designed for reliability) have a much greater likelihood of meeting reliability based entry criteria for operational test phases.

Figure 4 shows the distribution of root failure causes for the 51 programs that did not meet their reliability thresholds between 1997 and 2012. The root causes include: 1) inadequate systems management (failures traceable to incorrect interpretation or implementation of requirements, processes, or procedures); implementation of "bad" requirements (missing, inadequate, ambiguous, or conflicting); or failure to provide the resources required to design and build a robust system; 2) inadequate design margins (failures resulting from lack of design robustness to the stresses and loads in usage environment); 3) inadequate software (failures of a system to perform its intended function due to software issues); 4) induced failures (failures resulting from externally applied stresses such as operator or maintainer interfaces); 5) part quality (random failures); and 6) manufacturing anomalies.

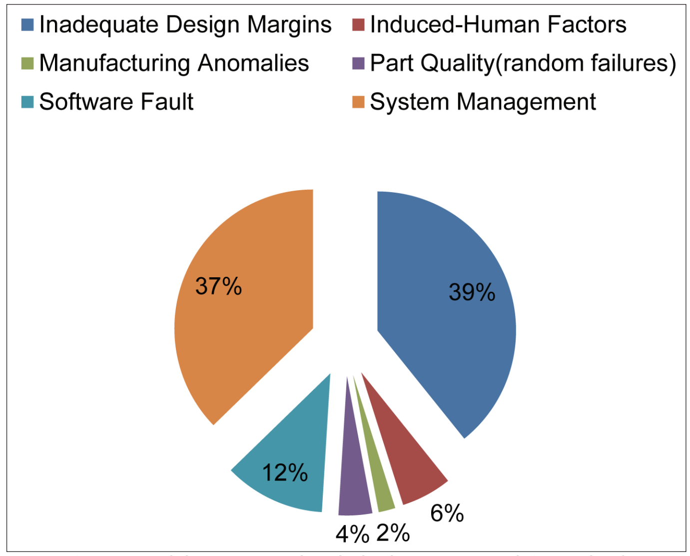

FIGURE 4. ROOT FAILURE CAUSES FOR THE 51 PROGRAMS NOT MEETING RELIABILITY THRESHOLDS BETWEEN FY97 AND FY12

Inadequate design margins and system management combine to account for 76 percent of the root causes for reliability failures in these data. Clearly, inadequate attention to reliability during engineering design, and inadequate management focus on best practices for reliability design and growth testing have been and continue to remain a concern – improvements in these areas, particularly using a Design For Reliability strategy, would help programs get on their planned reliability growth curve and have a greater likelihood of meeting their ultimate reliability goals. Additionally, software reliability design and growth testing are of concern. The 12 percent of systems that failed due to software root causes in Figure 4 are mostly software intensive systems like APG-79 Active Electronically Scanned Array (AESA) Radar (software immaturity causes excessive and inexplicable radar hang-ups; the built-in test function is not automated to isolate software failures); F-15 Mission Planning System (suitability is poor due to software instability, high frequency of system crashes); and Large Aircraft Infrared Countermeasures (LAIRCM) Phase II (software design bugs caused 19 critical failures; bugs were traced to software coding errors).

SOFTWARE TESTING

I continue to see software issues in programs of all types. Most commonly, programs do not create adequate ability to track software reliability and test software patches. Software requirements are poorly stated and in some cases wrongly tested. There are also unique needs for the special class of programs, business systems, which are being developed by the Services to meet the 2014 and 2017 Congressional deadlines for auditability.

Software Reliability

Software reliability is broadly similar to reliability for any weapon system with subtle distinctions in failure definitions, defect tracking, and the speed of the test-fix-test cycle. The overall effect of these distinctions has led me to conclude that new policy is needed that will the mandate the use of some software test automation for most programs that utilize software.

Failure Definition and Defect Tracking: Software is nearly always multi-functional. Software use is not well represented by failure-per-hour metrics. Except in cases where the same operation is performed repeatedly (for example spacecraft during planetary cruise), programs should simply track counts of defects. Defects should always be categorized by severity in accordance with Institute for Electrical and Electronics Engineers standards. Programs should track open and closure rates of the defects in each category. For multi-functional systems, it is helpful to track defects against distinct capabilities as well.

Test-Fix-Test: The test-fix-test cycle for software is faster and less visible than for other systems types. For many software issues, there is no meaningful distinction between maintenance and follow-on development. Given the speed of software development, the inability to oversee software in detail, and the fact that one must develop code to fix code, the line between fixing defects and adding features is nearly always blurred. Given the pace at which new security patches and product updates and changes in the computing environment occur, there is also essentially no such thing as a stable software system. For all of these reasons, I have concluded that operational testing of software must include a demonstration of the program's ability to perform robust and repeatable testing in support of software maintenance.

In support of robust and repeatable within-program testing, I have begun enforcing the following test automation policies, which will be contained in the next version of the DoDI 5000.02:

- *At Milestone A, program managers shall identify an approach to software test automation, including when key test automation software components or services will be acquired and how those decisions will be made. The test automation approach shall be updated in the Milestone B and Milestone C TEMPs as appropriate.*
- *Program managers shall demonstrate system sustainment maturity at IOT&E. Sustainment maturity shall include routine T&E to support routine technology upgrades. For Information Systems, Defense Business Systems, and software components of Weapons Systems, program managers shall demonstrate mature test automation to include an end-to-end trace of test information from requirements to test scripts to defect tracing*

This year, I recommended the following programs demonstrate this test-fix-test cycle: Next Generation Enterprise Network (NGEN), Integrated Strategic Planning and Analysis Network (ISPAN), Defense Enterprise Accounting and Management System (DEAMS), EProcurement, and Global Combat Support System – Army (GCSS-Army). Because the development of automation tools can be time consuming given the complexity of many of these programs, I anticipate that most programs will take several years to create an automated test-fix-test approach to satisfy these recommendations. Currently, very few acquisition programs have mature test automation solutions for regression testing that can be demonstrated at IOT&E and even fewer can create the environments and conditions to validate their regression testing processes. Without substantial help from a central resource, it is likely that most programs will have this deficiency assessed during IOT&E.

The need for test automation will create demand for the corresponding expertise in program offices. Program managers need a resource in the form of a center of excellence to help meet that demand, and DOT&E is taking the initial steps to establish such a center. The center of excellence would work with vendors and government providers to promote the use of various test automation solutions under the construct of "Test as a Service (TaaS)." A center of excellence will:

- Centralize knowledge of the various automation approaches
- Assist programs in applying test automation
- Create "in-house" test automation expertise

A center of excellence TaaS capability may lessen the tendency of program offices and vendors to use a "stove-piped" approach to test automation, may reduce duplicative resources (technological and human), should increase programs' use of existing capabilities, and should improve the consistency and adequacy in the types of testing accomplished.

Testers do not have questions about system maturity that are distinct from the questions the systems managers should have. System managers should always know how well the system is functioning. If testers have reasonable questions about system performance that the system managers cannot answer with the data they are already gathering, then the system management probably is not as mature as it should be. Examples of performance parameters that should be routinely and continuously reported to the system management include defect tracking, helpdesk use, system productivity/utilization, schedule of upcoming changes (commercial releases, changes in interfacing system, etc.), staff turnover rate, and training and documentation adequacy.

Software Requirements

Software requirements typically involve KPPs for system response time, data loss and restoration, and data transmission accuracy. DOT&E has seen many examples of metrics that incorrectly capture this information. For example, a KPP might specify 95 percent accuracy for information retrieval; but if a random 5 percent of your data is garbled every time you use the system, the utility of that system is very much in question. Some programs include requirements for data loss in event of an outage or other emergency that requires a system restore from backups, and these are almost always expressed as percentages. The data loss requirements should be expressed in time, not percentages. In every case, the system is expected to lose 100 percent of the data that has been entered following the most recent backup interval before the outage. I have seen that testers are dutifully reporting the amount of data loss, but that is not meaningful. Rather, testers should always perform a demonstration test that verifies the ability of the system to backup and restore data on a schedule consistent with the operational need for the system to be available for use.

Finally, some programs have percentage KPPs for data accuracy. These KPPs reference a variety of technical circumstances: transmission across interfaces, retrieval from databases, account balances, and so on. These are often treated as global metrics but they should be treated as percentages that apply to some relevant set of channels. For example, in general, once an interface is correct it is always correct. It is much less important to know that 95 percent of the data transmitted across all interfaces is correct than it is to know which 5 percent of the interfaces are transmitting incorrectly. The metric should not simply be the global number of errors per the number of transmissions. The mission need is for the data elements with errors to be limited. Therefore, the metrics should be looking at counts of element types containing errors. Global metrics also contribute less to finding and fixing problems than would differentiated metrics.

Vulnerability of Business Systems

The HOUSE ARMED SERVICES COMMITTEE PANEL ON DEFENSE FINANCIAL MANAGEMENT AND AUDITABILITY REFORM FINDINGS AND RECOMMENDATIONS (January 24, 2012), Recommendation 4.9 directed DOT&E and others to identify and address shortfalls in workforce levels and corresponding skill sets for Enterprise Resource Programs (ERPs). A clear shortfall in the testing of these systems is in identification of financial vulnerabilities. I have accordingly begun directing that the financial vulnerabilities of ERPs be probed in a manner analogous to Information Assurance, and anticipate that such testing will draw, at least initially, on the existing commercial services that provide such testing. The programs to which this applies are:

- Air Force Integrated Personnel and Pay System (AF-IPPS)
- Defense Agency Initiative (DAI)
- Defense Enterprise Accounting and Management System – Increment 1 (DEAMS – Increment 1)
- Defense Enterprise Accounting and Management System – Air Force (DEAMS – AF)
- EProcurement
- Future Pay and Personnel Management Solution (FPPS – Navy) Pre-MAIS
- General Fund Enterprise Business System (GFEBS)
- Global Combat Support System – Army (GCSS – Army)
- Integrated Personnel and Pay System – Army (Army IPPS)
- Navy Enterprise Resource Planning (ERP)

In support of this initiative, the DCMO has initiated a study of commercial providers of financial Red Team test services. In general, commercial vendors of these services focus on protect and detect capabilities (both system and people). They work with their clients to identify likely targets for fraud or theft within the system; they may attempt (within established rules of engagement) to circumvent controls and processes; and they assess the audit processes that are in place to catch fraud or theft. In addition, together with the Deputy Chief Management Officer, DASD(DT&E), and DASD(SE), we will ensure that developmental and operational testing helps fulfill the Federal Information System Controls Audit Manual requirements.

OTHER AREAS OF INTEREST

Electronic Warfare Test Infrastructure

In February 2012, I identified shortfalls in electronic warfare test resources that prevent adequate developmental and operational testing of many systems, including, but not limited to, the Joint Strike Fighter. I am working to address these shortfalls in government anechoic chambers, open-air ranges, and the Joint Strike Fighter electronic warfare programming laboratory. My staff participated in a "tiger team" assigned by the USD(AT&L) to review the issue, which concurred with my conclusions and recommended additional enhancements.

Cyber Testing

Implementation of the February 2011 Chairman of the Joint Chiefs Execute Order (EXORD), which directed increased cyber-adversary realism for training events, has been modest. During FY12, most of the exercise assessments and tests involved operations largely against low- and mid-level cyber threats and on networks that were only moderately stressed in terms of loading or network degradation. In the cases where the adversary team portrayed higher-level threats, exercise training audiences frequently misinterpreted these portrayals as maintenance issues, poor system performance, or anomalies. This indicates that the Department has not yet developed sufficiently advanced cyber defensive tactics to counter advanced adversary tactics and to consistently operate in degraded cyber environments. Following publication of the FY11 Annual Report, I provided a separate and classified amplification of findings, which resulted in a series of meetings with the Deputy Secretary of Defense on the topic of how these operational and training shortfalls might be resolved. A number of actions resulting from these discussions are in progress, including the consolidation and enhancement of training support capabilities, additional guidance on meeting the intent and requirements of the EXORD, and improving the way the Department ensures that critical shortfalls are resolved. Additionally, the lessons garnered from operational network assessments are being applied to the acquisition and testing of information systems to ensure that subsequent systems procurement does not contain cyber shortfalls already discovered and documented by the Department. I also remain closely engaged with U.S. Cyber Command and other key stakeholders to ensure priority is given to the necessary investments supporting improved Red Team availability, capability, and accessibility.

Testing Protocols for Personal Protective Equipment

I continue to exercise oversight over the testing of personal protective equipment. The National Academy of Sciences' Committee to Review the Testing of Body Armor published its final report in May of 2012 and I and the Services are pursuing the report's recommendations. Congressional interest in the testing of the Army's Advanced Combat Helmet (ACH) resulted in the Department's Inspector General initiating a technical assessment of the ACH. In response to this Congressional interest in the ACH, we have also asked the NRC to conduct an independent review of the helmet testing protocols. This is a direct follow-up to the NRC's independent review of hard body armor testing, which included a review of test protocols. One of the objectives of the review is to examine the rigor of statistical metrics. My staff will leverage the knowledge of some of the nation's leading statisticians to improve and advance the use of statistical techniques in test. I will also conduct a comprehensive technical assessment of the ACH to characterize its ballistic performance more comprehensively than is possible with existing data. The results of these assessments will provide the basis for any changes to the current helmet test protocols that might be appropriate.

Warrior Injury Assessment Manikin (WIAMan)

I am sponsoring a five-year research and development program to increase the Department's understanding of the cause and nature of injuries incurred in underbody blast combat events and to develop appropriate instrumentation to assess such injuries in testing. This program, known as the Warrior Injury Assessment Manikin, utilizes expertise across multiple commands and disciplines within the Army to generate a medical research plan from which data will, at pre-determined times, be transitioned to the materiel and T&E communities. These data will feed the design of a biofidelic prototype Anthropomorphic Test Device designed to capture occupant loading from the vertical direction, reflecting the primary load axis to which occupants are exposed in an under-vehicle blast event.

Environment and Renewable Energy Effects on Test Ranges

The Department's ranges are experiencing encroachment from infrastructure associated with the electrical energy production and transmission industry. This encroachment can affect test operations as well as systems under test through a variety of means. These include physical obstructions, electromagnetic interference, and thermal effects. The sources of such encroachment include wind turbines, solar power towers, photovoltaic panels, and high voltage bulk power transmission lines. I will continue to cooperate with the Department's Siting Clearing House and the Services to identify potential encroachment of our ranges resulting from renewable energy infrastructure and work to mitigate the impact of such encroachment.

CONCLUSION

Since my first report to you in 2009, we have made significant progress increasing the scientific and statistical rigor of OT&E; we have engaged early with the requirements community to develop realistic, feasible, and testable requirements; we have focused attention on reliability management, design, and growth testing; and we continue to support rapid fielding through flexible and early operational test events. I submit this report, as required by law, summarizing the operational and live fire T&E activities of the Department of Defense during FY12.

J. M. Gilmore

J. Michael Gilmore
Director

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DOT&E Activity and Oversight

DOT&E Activity and Oversight

Activity Summary

DOT&E activity for FY12 involved oversight of 327 programs, including 41 Major Automated Information Systems (MAIS). 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 FY12 included approval of 43 Test and Evaluation Master Plans (TEMPs) and 1 Test and Evaluation Strategy, as well as 73 Operational Test Plans and 1 Live Fire Test and Evaluation (LFT&E) Management Plan. In FY12, DOT&E prepared for the Secretary of Defense and Congress 14 Beyond Low-Rate Initial Production (BLRIP) reports, 2 Early Fielding reports, 6 Follow-on Operational Test and Evaluation (FOT&E) reports, 2 LFT&E reports, 1 MAIS report, and 2 special reports, as well as the Ballistic Missile Defense (BMD) Programs FY11 Annual Report. Additional FY12 DOT&E reports that did not go to Congress included 25 Operational Assessment reports, 1 FOT&E report, 1 LFT&E report, 6 MAIS reports, and 3 special reports.

DOT&E also prepared and submitted numerous reports to the Defense Acquisition Board (DAB) principals for consideration in DAB deliberations.

During FY12, DOT&E 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 Under Secretary of Defense (Acquisition, Technology and Logistics), the Service Secretaries, and Congress. Active onsite participation in, and observation of, tests and test-related activities are a primary source of information for DOT&E evaluations. In addition to onsite participation and local travel within the National Capital Region, approximately 925 trips supported the DOT&E mission.

Security considerations preclude identifying classified programs in this report. The objective, however, is to ensure operational effectiveness and suitability do not suffer due to extraordinary security constraints imposed on those programs.

TEST AND EVALUATION MASTER PLANS / STRATEGIES APPROVED

Advanced Extremely High Frequency (AEHF) Satellite Communications System TEMP

Advanced Medium-Range Air-to-Air Missile (AMRAAM) Electronic Protection Improvement Program (EPIP) TEMP

Air and Space Operations Center – Weapon System (AOC-WS), Increment 10.1 TEMP

Air Force Integrated Personnel and Pay System (AF-IPPS) TEMP

Amphibious Assault Ship Replacement (LHA (R)) TEMP

AN/ALR-69A Radar Warning Receiver Program TEMP

Apache Block III (AB3) TEMP

Army Integrated Air and Missile Defense TEMP

Automatic Radar Periscope Detection and Discrimination (ARPDD) Upgrade TEMP

B-61 Life Extension Program Tailkit Assembly Test and Evaluation Strategy

Battle Control System – Fixed (BCS-F), Increment 3, Release 3.2 (R3.2) TEMP

Cooperative Engagement Capability (CEC) TEMP Revision 5

Defense Enterprise Accounting and Management System (DEAMS) TEMP

Distributed Common Ground System – Army (DCGS-A) Increment 1 TEMP

Distributed Common Ground System – Marine Corps (DCGS-MC) Milestone B TEMP

Enhanced AN/TPQ-36 (EQ-36) Milestone C Update TEMP

EProcurement (EProc) TEMP

EProcurement Addendum to Milestone C TEMP

F/A-18E/F and EA-18G Flight Plan TEMP No. 1787

Global Broadcast Service (GBS) TEMP

Global Positioning System (GPS) Enterprise TEMP (ETEMP)

Ground/Air Task Oriented Radar (G/ATOR) TEMP

Guided Multiple Launch Rocket System – Alternate Warhead (GMLRS – W) Milestone B TEMP

Integrated Defensive Electronic Countermeasures (IDECM) Suite Block 4 TEMP

Integrated Defensive Electronic Countermeasures (IDECM) Suite Block 4 TEMP No. 1490 Annex C Change

Integrated Submarine Imaging System (ISIS) Program TEMP

Joint High Speed Vessel (JHSV) TEMP

Joint Lightweight Tactical Vehicle (JLTV) Increment I Milestone B TEMP

Joint Warning and Reporting Network (JWARN) Increment I TEMP

Key Management Infrastructure (KMI) Increment 2 TEMP

M109 Family of Vehicles Paladin Integrated Management (PIM) TEMP

Mark XIIA Mode 5 Identification Friend or Foe (IFF) TEMP

Mk 48 Mod 7 Common Broadband Advanced Sonar System (CBASS) and the Mk 48 Mod 6 Advanced Common Torpedo with Advanced Processor Build (APB) Spiral 4 TEMP No. 0371

MQ-1C Increment 1 Gray Eagle (GE) Unmanned Aircraft System (UAS) TEMP

MQ-4C Broad Area Maritime Surveillance (BAMS) Unmanned Aircraft System (UAS) TEMP

MQ-9 Reaper Increment 1 Unmanned Aircraft System TEMP

MQ-9 Reaper Increment 1 Unmanned Aircraft System TEMP Update 1

RC-135 Multi-functional Information Distribution System (MIDS) Joint Tactical Radio System (JTRS) Integration TEMP

Remote Minehunting System (RMS) TEMP Revision D

Rolling Airframe Missile (RAM) Block 2 TEMP

Ship-to-Shore Connector (SSC) TEMP

Space-Based Infrared System (SBIRS) Enterprise TEMP (ETEMP)

Submarine Electronic Warfare Support (ES) System (AN/BLQ-10) TEMP

Surface Mine Countermeasures Unmanned Undersea Vehicle (SMCM UUV) TEMP (February 2012)

Surface Mine Countermeasures Unmanned Undersea Vehicle (SMCM UUV) TEMP (August 2012)

Teleport, Generation 3, Phase 2 (G3P2) TEMP Update

Virginia (SSN 774) TEMP with Design of Experiments (DOE) Appendix

Warfighter Information Network – Tactical (WIN-T) Increment 2 TEMP

OPERATIONAL TEST PLANS APPROVED

Advanced Extremely High Frequency (AEHF) Operational Utility Evaluation (OUE) 2 Operational Test Agency (OTA) Test Plan

Aegis Baseline 7.1R and Cooperative Engagement Capability (CEC) FOT&E Test Plans

Air and Space Operations Center (AOC) – Weapon System (WS) Increment 10.1 Recurring Event (RE) 11 Force Development Evaluation (FDE) Plan

Air and Space Operations Center (AOC) – Weapon System (WS) Increment 10.1 Overarching OT&E Plan

Air Intercept Missile-9X Block II IOT&E Plan

Airborne Warning and Control System (AWACS) Block 40/50 Upgrade IOT&E Plan

AN/ALR-69A Radar Warning Receiver (RWR) IOT&E Test Plan

Apache Block III Force Development Test and Experimentation II (FDT&E II) and IOT&E Operational Test Agency (OTA) Test Plan

Automatic Radar Periscope Detection and Discrimination (ARPDD) Upgrade IOT&E Plan

B-2 EHF SATCOM Increment 1 IOT&E Plan

Battle Control System – Fixed Release 3.2 (BCS-F R3.2) IOT&E Plan

C-130 Avionics Modernization Program IOT&E Test Plan

C-130J Data Transfer and Diagnostics System (DTADS) FOT&E Plan

C-130J Station Keeping Equipment (SKE) Software Enhancement (SSE) FOT&E-2 Plan

C-5 Reliability Enhancement and Re-Engining Program Operational Flight Program 3.5 FDE Test Plan

CNO Project No. 1714, Enterprise Test (ET-03) Phase 2 of the Air Warfare/Ship Self-Defense (AW/SSD) Enterprise, CNO Project 1400, FOT&E (OT-IIIF) of the Ship Self-Defense System (SSDS) Mark 2 Mod 1A and CNO Project 1471, FOT&E (OT-D2) of the Evolved SeaSparrow Missile (ESSM) Program

CNO Project No. 1787, FOT&E OT-D1 of the EA-18G Airborne Electronic Attack Aircraft System Configuration Set H8E Test Plan

CNO Project No. 3980 1552-OT-B2/1583-OT-B2, Operational Assessment (OA) (OT-B2) of the MH-60S Block 2 Airborne Mine Countermeasures System (AMCM) and the AN/AES-1 Airborne Laser Mine Detection System (ALMDS) Test Plan

CNO Project No. J1656, MOT&E (OT-D3) of the Mobile User Objective System (MUOS) Test Plan

Common Aviation Command and Control System (CAC2S), Increment 1, Phase 1 Limited User Evaluation Plan

Consolidated Afloat Networks and Enterprise Services (CANES) OA Test Plan

Cooperative Engagement Capability (CEC) FOT&E (OT-IIIF) Test Plan

Distributed Common Ground System – Army (DCGS-A) Increment 1, DCGS-A Software Baseline (DSB) 1.0 IOT&E OTA Test Plan (TP)

Distributed Common Ground System – Navy (DCGS-N) FOT&E Plan

Dry Cargo and Ammunition Ship (T-AKE) Program Change Transmittal II to Test Plan

E-2D Advanced Hawkeye (AHE) IOT&E/CEC FOT&E Test Plan

EProcurement Release 1.2 IOT&E Plan

EProcurement Release 1.2 OA Test Plan

F/A-18/F System Configuration Set (SCS) H8E Software Qualification Test (SQT) And Active Electronically Scanned Array (AESA) Radar Upgrade Phase III OT&E Plan

Gerald R. Ford Class CVN-78 Aircraft Carrier Test Plan for OA OT-B3

Global Command and Control System – Joint (GCCS-J) Global Version 4.2.0.9 Release OT&E Plan

H-1 Upgrades Program FOT&E (OT-IIIB) Test Plan

HC/MC-130J Recapitalization (RECAP) IOT&E Plan

Integrated Defensive Electronic Countermeasures (IDECM) Suite Block 4 OA Test Plan

Integrated Personnel and Pay System – Army (IPPS-A) Test and Evaluation Plan (TEP)

Integrated Strategic Planning and Analysis Network (ISPAN) Increment 2 IOT&E Plan

Joint Chemical Agent Detector (JCAD) Visit, Board, Search, Seizure (VBSS) OTA Test Plan for Developmental Test/Operational Test (DT/OT)

Joint Space Operations Center (JSpOC) Mission System (JMS) Increment 1 OUE OTA Test Plan

Joint Space Operations Center (JSpOC) Mission System (JMS) Increment 2 Early OA (EOA) Plan

Joint Tactical Radio System (JTRS) Enterprise Network Manager (JENM) for Soldier Radio Waveform (SRW) IOT&E Test Plan

Joint Tactical Radio System (JTRS) Handheld, Manpack, Small Form Fit (HMS) Manpack Radio MOT&E OTA Test Plan

Joint Tactical Radio System (JTRS) Handheld, Manpack, Small Form Fit (HMS) Rifleman Radio IOT&E OTA Test Plan

Joint Warning and Reporting Network (JWARN) Increment 1 FOT&E OTA Test Plan

Key Management Infrastructure (KMI) Increment 2, Spiral 1, IOT&E Plan

Littoral Combat Ship (LCS) Quick Reaction Assessment (QRA) Data Management and Analysis Plan (DMAP)

LPD-17 Data Management and Analysis Plan (DMAP) for Deficiency concerning reliability during the first five hours of Amphibious Assault (R5)

LPD-17 FOT&E Test Plan for Chemical, Biological, Radiological Defense (CBRD) and Magnetic Signature Check Range Run

Mark XIIA Identification Friend or Foe (IFF) Mode 5 Joint Operational Test Approach (JOTA) Test Plan

Mark XIIA Identification Friend or Foe (IFF) Mode 5 Joint Operational Test Approach (JOTA) Version 2.0

Miniature Air-Launched Decoy – Jammer (MALD-J) ADM-160C IOT&E Test Plan

Mk 48 Test Plan

Mk 48 Mod 6 Advanced Common Torpedo (ACOT) and Mk 48 Mod 7 Common Broadband Advanced Sonar System (CBASS) Torpedo FOT&E Test Plan

Mk 54 Test Plan Change 1

MQ-1C Gray Eagle Unmanned Aircraft System IOT&E OTA Test Plan

MQ-9 Operational Flight Program 904.2 FDE Plan

MV-22B Block C FOT&E Test Plan

Ohio Class Replacement Submarine EOA Test Plan (1771-OT-A1)

P-8A Poseidon Multi-mission Maritime Aircraft (MMA) IOT&E Test Plan

Patriot Limited User Test (LUT) OTA Test Plan

RC-135 Multi-functional Information Distribution System (MIDS) Joint Tactical Radio System (JTRS) Integration Test Plan

Small Diameter Bomb Increment II (SDB II) Multi-Service OA Plan

Space Fence EOA OTA Test Plan

Space-Based Infrared System Effectivity 5 OUE OTA Test Plan

Standard Missile-6 (SM-6) OT-IIB IOT&E Test Plan Annex A Model and Simulation Runs for the Record (RFR) (U)

Stryker Double-V Hull (DVH) Mortar Carrier Vehicle (MCVV) OTA Test Plan

Stryker Double-V Hull (DVH) Addendum to the LFT&E Phase 2/3 OTA Test Plan and the Detailed Test Plan (DTP)

Submarine Electronic Warfare Support (ES) System (AN/BLQ-10) Integrated Evaluation Framework (IEF)

Surveillance Towed Array Sensor System (SURTASS) Compact Low Frequency Active (CLFA) Test Plan for IOT&E (OT-IIG)

Teleport Generation 3, Phase 2 (G3P2) OA OTA Plan

U.S. Air Forces Central (AFCENT) Combined Air and Space Operations Center (CAOC) Information Assurance Assessment Plan

Vertical Take-off and Landing Tactical Unmanned Aerial Vehicle (VTUAV) System Quick Reaction Assessment (QRA) Data Management and Analysis Plan (DMAP)

Warfighter Exercise (WFX) 12-4 Information Assurance and Interoperability Assessment Plan

Warfighter Information Network – Tactical Increment 2 IOT&E OTA Test Plan

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LIVE FIRE TEST AND EVALUATION STRATEGIES, TEST PLANS, AND MANAGEMENT PLANS

57 mm Ammunition LFT&E Management Plan

FY12 DOT&E REPORTS TO CONGRESS		
Program	**Report Type**	**Date**
BLRIP Reports		
Stryker Nuclear, Biological, and Chemical Reconnaissance Vehicle (NBCRV)	Combined OT/LFT	November 2011
Navy Multiband Terminal (NMT) with Classified Annex	OT Report	November 2011
Large Aircraft Infrared Countermeasure (LAIRCM) Phase II System	OT Report	January 2012
Global Positioning System Selective Availability/Anti-Spoof Module (GPS SAASM)	Multi-Service OT Report	February 2012
Terminal High-Altitude Area Defense (THAAD) and AN/TPY-12 Radar	Combined OT/LFT	February 2012
Spider XM7 Network Command Munition with Confidential Annex	Combined OT/LFT	February 2012
Mine Resistant Ambush Protected (MRAP) Family of Vehicles: Dash with Independent Suspension System (ISS), MRAP Recovery Vehicle (MRV), Marine Corps Cougar Ambulance	Combined OT/LFT	March 2012
Global Combat Support System – Army (GCSS-Army)	OT Report	June 2012
Direct Attack Moving Target Capability (DAMTC)	OT Report	June 2012
Mark XIIA Mode 5 Identification Friend or Foe (IFF) System	OT Report	July 2012
AH-64D Apache Block III (AB3) Attack Helicopter with Classified Annex	Combined OT/LFT	August 2012
AGM-88E Advanced Anti-Radiation Guided Missile (AARGM)	OT Report	August 2012
Warfighter Information Network – Tactical (WIN-T) Increment 2 with Classified Annex	OT Report	September 2012
Common Remotely Operated Weapon Station (CROWS)	OT Report	September 2012
Early Fielding Reports		
Mk 54 Lightweight Torpedo with Block Upgrade (BUG) Software	OT Report	January 2012
Massive Ordnance Penetrator (MOP)	OT Report	April 2012
FOT&E Reports		
Virginia Class Submarine Low Frequency Active (LFA) (ACCM)	OT Report	November 2011
Tomahawk Land Attack Missile	OT Report	February 2012
Verification of Correction of Deficiencies Report on the Multi-functional Information Distribution System (MIDS) Joint Tactical Radio System (JTRS)	OT Report	March 2012
EA-18G Airborne Electronic Attack (AEA) Aircraft	OT Report	March 2012
F/A-18E/F Super Hornet	OT Report	April 2012
Combined MH-60R Multi-Mission Helicopter and the MH-60S Multi-Mission Combat Support Helicopter Preplanned Product Improvement (P3I) Program	OT Report	April 2012
LFT&E Reports		
Family of Medium Tactical Vehicles (FMTV) A1P2	LFT Report	October 2011
Enhanced Combat Helmet (ECH)	LFT Report	May 2012
MAIS Reports		
EProcurement System	OT Report	June 2012
Special Reports		
Active Protection Systems (APS) Live Fire Test and Evaluation	LFT Report	February 2012
Assessment of Department of Defense (DoD) Information Assurance during Major Combatant Command (CCMD) Service Exercises	Information Assurance	April 2012
BMD Reports		
FY11 Assessment of the Ballistic Missile Defense System (BMDS) (includes classified appendices A, B, C)	Annual Report	February 2012

OTHER FY12 DOT&E REPORTS		
Program	**Report Type**	**Date**
Operational Assessment Reports		
MQ-9 Unmanned Aerial System (UAS)	OT Report	October 2011
B-2 Extremely High Frequency (EHF) Satellite Communications (SATCOM) and Computer Upgrade Increment 1	OT Report	October 2011
AN/AAR-47 Missile Warning Set (MWS) Hostile Fire Indication (HFI) Software Upgrade, Operational Flight Program (OFP) 30.41	OT Report	October 2011
Key Management Infrastructure (KMI) Spiral 1	OT Report	October 2011
Surveillance Towed Array Sensor System (SURTASS) with Compact Low Frequency Active (CLFA)	OT Report	October 2011
Stryker Double-V Hull (DVH) Configuration of the Engineer Squad Vehicle (ESVV)	Combined OT/LFT	October 2011
Family of Medium Tactical Vehicles (FMTV) A1P2	Combined OT/LFT	October 2011
Stryker Double-V Hull (DVH) Configuration of the Infantry Carrier Vehicle (ICVV) Scout	Combined OT/LFT	January 2012
Network Integration Evaluation (NIE) 11.2 with Classified Annex	OT Report	January 2012
Distributed Common Ground System – Army (DCGS-A) Software Baseline (DSB) 1.0	OT Report	January 2012
Block Cycle Change 03 (BCC 03) for the C-5 Avionics Modernization Program (AMP)	OT Report	February 2012
C-17 Formation Flight System (FFS)	OT Report	February 2012
C-130J Station Keeping Equipment (SKE) Software Enhancement (SSE)	OT Report	February 2012
Integrated Strategic Planning and Analysis Network (ISPAN) Increment 2, Spiral 1	OT Report	March 2012
MQ-1C Gray Eagle Unmanned Aircraft System (UAS)	OT Report	April 2012
Department of Defense Teleport System, Generation Three Phase Two	OT Report	May 2012
Stryker Double-V Hull (DVH) Configuration of the Mortar Carrier Vehicle (MCVV)	Combined OT/LFT	May 2012
MH-60S Airborne Mine Countermeasures Helicopter and AN/AQS-20A Mine Detecting Sonar	Combined OT/LFT	June 2012
Visit, Board, Search, and Seizure (VBSS) Joint Chemical Agent Detector (JCAD)	OT Report	July 2012
Stryker Double-V Hull (DVH) Configuration of the Medical Evacuation Vehicle (MEVV)	Combined OT/LFT	July 2012
Joint Tactical Radio System (JTRS) Handheld, Manpack, Small Form Fit (HMS) Manpack Radio and Joint Enterprise Network Manager (JENM)	OT Report	July 2012
Joint Tactical Radio System (JTRS) AN/PRC-154 Rifleman Radio and Soldier Radio Waveform Network Manager (SRWNM)	OT Report	August 2012
Mine Resistant Ambush Protected (MRAP) Family of Vehicles: Navistar Dash Ambulance and MRAP All-Terrain Vehicle (M-ATV) Underbody Improvement Kit (UIK)	Combined OT/LFT	August 2012
MQ-9 Reaper Block 5 Remotely Piloted Aircraft	OT Report	September 2012
Defense Enterprise Accounting and Management System (DEAMS) Increment 1 Release 1	OT Report	September 2012
FOT&E Reports		
BAE-Tactical Vehicle System (TVS) Caiman Mine Resistant Ambush Protected (MRAP) Vehicle	LFT&E Report	June 2012
LFT&E Reports		
Stryker Double-V Hull (DVH) Configuration of the Commander's Vehicle (CVV)	LFT&E Report	January 2012
MAIS Reports		
Battle Control System – Fixed (BCS-F) Increment 3.1	OT Report Update 1	October 2011
Joint Mission Planning System – Expeditionary (JMPS-E)	IOT&E Report	October 2011
Public Key Infrastructure (PKI) Increment 2	IOT&E Report	January 2012
Global Command and Control System – Joint (GCCS-J) Version 4.2.0.9	OT Report	January 2012
Joint Mission Planning System (JMPS) E-8 Joint Surveillance Target Attack Radar System (JSTARS) Mission Planning Environment (MPE)	IOT&E Report	February 2012
Battle Control System – Fixed (BCS-F) Increment 3, Release 3.1 (R3.1)	OT Report Update 2	May 2012
Special Reports		
Hellfire Romeo Missile	LFT&E Report	November 2011
Stryker Mobile Gun System (MGS) Engineering Change Order (ECO) Block 3	Combined OT/LFT	January 2012
Surface-Launched Advanced Medium-Range Air-to-Air Missile (SLAMRAAM)	OT Report	May 2012

Program Oversight

DOT&E is responsible for approving the adequacy of plans for operational test and evaluation and for reporting the operational test results for all major defense acquisition programs to the Secretary of Defense, Under Secretary of Defense (Acquisition, Technology and Logistics), Service Secretaries, and Congress. 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 (U.S.C.) (Selected Acquisition Reports (SARs)). The law (Section 139(a)(2)(B)) also stipulates that DOT&E may designate any other programs for the purpose of oversight, review, and reporting. With the addition of such "non-major" programs, DOT&E was responsible for oversight of a total of 327 acquisition programs during FY12.

Non-major programs are selected for DOT&E oversight after careful consideration of the relative importance of the individual program. In determining 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 (Section 139(b)(4)) requires 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 operational testing is not yet complete.

This office is also responsible for the oversight of LFT&E programs, in accordance with 10 U.S.C 139. DoD regulation uses the term "covered system" to include all categories of systems or programs identified in 10 U.S.C. 2366 as requiring LFT&E. In addition, systems or programs that do not have acquisition points referenced in 10 U.S.C. 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 U.S.C. 2302(5), that is:
  - User-occupied and designed to provide some degree of protection to the system or its occupants in combat
  - 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.

DOT&E was responsible for the oversight of 127 LFT&E acquisition programs during FY12.

Programs Under DOT&E Oversight Fiscal Year 2012

(As taken from the September 2012 DOT&E Oversight List)

DoD PROGRAMS

AC-130J

Ballistic Missile Defense System (BMDS) Program

Ballistic Missile Technical Collection (BMTC)

Chemical Demilitarization – Chemical Materials Agency (Army Executing Agent) (CHEM DEMIL-CMA)

Chemical Demilitarization Program – Assembled Chemical Weapons Alternatives (CHEM DEMIL-ACWA)

Conventional Prompt Global Strike

Defense Agency Initiative (DAI)

Defense Enterprise Accounting and Management System (DEAMS) Increment 1

Defense Readiness Reporting System – Strategic

Defense Security Assistance Management System (DSAMS) – Block 3

EProcurement

Global Combat Support System – Joint (GCSS-J)

Global Command and Control System – Joint (GCCS-J)

Integrated Electronic Health Record (iEHR)

Joint Aerial Layer Network

Joint Biological Standoff Detection System (JBSDS)

Joint Biological Tactical Detection System (JBTDS)

Joint Chemical Agent Detector (JCAD)

Joint Command and Control Capabilities (JC2C) [Encompasses GCCS-FoS (GCCS-J, GCCS-A, GCCS-M), TBMCS-FL, DCAPES, GCCS-AF, USMC JTCW, USMC TCO]

Joint Tactical Radio System (JTRS) Airborne and Maritime/Fixed Station (AMF)

Joint Tactical Radio System (JTRS) Enterprise Network Manager (JENM)

Joint Tactical Radio System (JTRS) Handheld, Manpack, and Small Form Fit (HMS) Radios

Joint Tactical Radio System (JTRS) Network Enterprise Domain (NED)

Joint Warning and Reporting Network (JWARN)

Key Management Infrastructure (KMI) Increment 2

Mid-Tier Networking Vehicle Radio

Multi-Functional Information Distribution System (MIDS) (includes all current and planned integrations of MIDS JTRS into USAF and USN aircraft: F/A-18 E/F, E-2D, E-8, RC-135, EC-130 (all applicable series designations))

Next Generation Diagnostic System

Public Key Infrastructure (PKI) Increment 2

Soldier Radio Waveform (SRW) Network Manager

Special Operations Command Dry Combat Submersible Medium (DCSM)

Special Operations Command Next Generation Dry Deck Shelter

Teleport, Generation III

Theater Medical Information Program – Joint (TMIP-J) Block 2

Virtual Interactive Processing System (VIPS)

ARMY PROGRAMS

.300 Winchester Magnum Mk248 Mod 1 ammunition

25 mm Individual Semi-Automatic Airburst System (ISAAS)

Abrams Tank Modernization (M1E3)

Abrams Tank Upgrade (M1A1 SA / M1A2 SEP)

Apache Block III (AB3)

Armed Aerial Scout (previously named ARH Armed Recon Helicopter)

Armored Multi-Purpose Vehicle (AMPV)

Armored Truck – Heavy Dump Truck (HDT)

Armored Truck – Heavy Equipment Transporter (HET)

Armored Truck – Heavy Expanded Mobility Tactical Truck (HEMTT)

Armored Truck – M915A5 Line Hauler

Armored Truck – M939 General Purpose Truck

Armored Truck – Palletized Loading System (PLS)

Army Integrated Air and Missile Defense (AIAMD)

Army Vertical Unmanned Aircraft System

Biometrics Enabling Capability (BEC) Increment 1

Black Hawk Utility Helicopter (UH-60M) Upgrade Program

Bradley Fighting Vehicle System Upgrade

Bradley Modernization (M2A3 V2)

Cartridge, 7.62 mm, M80A1

ARMY PROGRAMS (continued)

CH-47F – Cargo Helicopter
Common Infrared Countermeasures (CIRCM)
Common Remotely Operated Weapon Station (CROWS) III
Distributed Common Ground System – Army (DCGS-A)
Enhanced AN/TPQ-36 Radar System (EQ-36)
Excalibur – Family of Precision, 155 mm Projectiles
FMTV – Family of Medium Tactical Vehicles
Force XXI Battle Command Brigade and Below – Joint Capability Release (FBCB2 – JCR)
Force XXI Battle Command Brigade and Below (FBCB2) Program
General Fund Enterprise Business System (GFEBS)
Global Combat Support System – Army (GCSS-Army)
Ground Combat Vehicle (GCV)
Guided Multiple Launch Rocket System (GMLRS) – Alternate Warhead (AW)
Guided Multiple Launch Rocket System (GMLRS) – Dual Purpose Improved Conventional Munitions (DPICM)
Guided Multiple Launch Rocket System (GMLRS) – Unitary
Hellfire Romeo
High Mobility Artillery Rocket System (HIMARS)
High Mobility Multi-purpose Wheeled Vehicle (HMMWV)
Hostile Fire Detection System
Individual Carbine
Integrated Personnel and Pay System – Army (Army IPPS)
Interceptor Body Armor
Javelin Anti-Tank Missile System – Medium
Joint Air-to-Ground Missile (JAGM)
Joint Assault Bridge
Joint Battle Command Platform (JBC-P)
Joint Cooperative Target Identification – Ground (JCTI-G)
Joint Future Theater Lift Concept (JFTLC)
Joint Land Attack Cruise Missile Defense Elevated Netted Sensor (JLENS) System
Joint Lightweight Tactical Vehicle (JLTV)
Joint Personnel Identification (JPIv2)
Kiowa Warrior Upgrade
Land Warrior – Integrated Soldier Fighting System for Infantrymen
Light Utility Helicopter (LUH)
Logistics Modernization Program (LMP)
Long Endurance Multi-Intelligence Vehicle (LEMV)
M1200 Knight Targeting Under Armor (TUA)
M270A1 Multiple Launch Rocket System (MLRS)
M829E4
Mark XIIA Identification Friend or Foe (IFF) Mode 5 (all development and integration programs)
Modernized Expanded Capacity Vehicle (MECV) – Survivability Demonstration
MQ-1C Unmanned Aircraft System Gray Eagle
Nett Warrior
One System Remote Video Terminal (OSRVT)
Paladin/Field Artillery Ammunition Supply Vehicle (FAASV) Integrated Management (PIM)
Patriot Advanced Capability 3 (PAC-3) (Missile only)
Patriot/Medium Extended Air Defense System (MEADS)
RQ-11B Raven – Small Unmanned Aircraft System
RQ-7B SHADOW – Tactical Unmanned Aircraft System
Spider XM7 Network Command Munition
Stryker M1126 Infantry Carrier Vehicle including Double-V Hull Variant
Stryker M1127 Reconnaissance Vehicle
Stryker M1128 Mobile Gun System
Stryker M1129 Mortar Carrier including the Double-V Hull Variant
Stryker M1130 Commander's Vehicle including the Double-V Hull Variant
Stryker M1131 Fire Support Vehicle Including the Double-V Hull Variant
Stryker M1132 Engineer Squad Vehicle Including the Double-V Hull Variant
Stryker M1133 Medical Evacuation Vehicle Including the Double-V Hull Variant
Stryker M1134 Anti-Tank Guided Missile (ATGM) Vehicle Including the Double-V Hull Variant
Stryker M1135 Nuclear, Biological, and Chemical Reconnaissance Vehicle (NBCRV) Including the Double-V Hull Variant
Stryker Modernization Program
Surface-Launched Advanced Medium-Range Air-to-Air Missile (SLAMRAAM)
Tactical Edge Network – Extension
Warfighter Information Network – Tactical (WIN-T) Increment 1
Warfighter Information Network – Tactical (WIN-T) Increment 2
Warfighter Information Network – Tactical (WIN-T) Increment 3
Warfighter Information Network – Tactical (WIN-T) Increment 4
XM1156 Precision Guidance Kit (PGK)
XM395 Accelerated Precision Mortar Initiative (APMI)

NAVY PROGRAMS

Acoustic Rapid Commercial Off-the-Shelf (COTS) Insertion (A-RCI) for SONAR

Advanced Airborne Sensor

Advanced Extremely High Frequency (AEHF) Navy Multiband Terminal (NMT) Satellite Program

Aegis Modernization

AGM-88E Advanced Anti-Radiation Guided Missile (AARGM)

AH-1Z

AIM-9X Air-to-Air Missile Upgrade Block II

Air and Missile Defense Radar (AMDR)

Air Warfare Ship Self-Defense Enterprise

Airborne Laser Mine Detection System (AN/AES-1) (ALMDS)

Airborne Mine Neutralization System (AN/ASW-235) (AMNS)

Amphibious Assault Vehicle Upgrade

Amphibious Combat Vehicle (ACV)

AN/APR-39 Radar Warning Receiver

AN/AQS-20A Minehunting Sonar

AN/BLQ-10 Submarine Electronics Support Measures

AN/BVY-1 Integrated Submarine Imaging System

AN/SQQ-89A(V) Integrated USW Combat Systems Suite

Anti-Torpedo Torpedo Defense System including all associated programs (Countermeasure Anti-Torpedo (CAT), Torpedo Warning System (TWS), and SLQ-25X (NIXIE))

AR/LSB – Airborne Resupply/Logistics for Seabasing

Assault Breaching System Coastal Battlefield Reconnaissance and Analysis System Block II

Broad Area Maritime Surveillance (BAMS) Unmanned Aircraft System

BYG-1 Fire Control (Weapon Control and TMA)

CH-53K – Heavy Lift Replacement Program

Close-In Weapon System (CIWS) including SEARAM

Cobra Judy Replacement – Ship-based Radar System

Common Aviation Command and Control System (CAC2S)

Consolidated Afloat Networks and Enterprise Services (CANES)

Cooperative Engagement Capability (CEC)

Countermeasure Anti-Torpedo

CVN-78 – *Gerald R. Ford* Class Nuclear Aircraft Carrier

CVN-78 – Electro-Magnetic Aircraft Launching System

DDG-1000 – *Zumwalt* Class Destroyer – includes all supporting PARMs and the lethality of the LRLAP, 57 mm and 30 mm ammunition

DDG-51 – *Arleigh Burke* Class Guided Missile Destroyer – includes all supporting PARMs

DDG-51 Flight III – *Arleigh Burke* Class Guided Missile Destroyer – includes all supporting PARMs

Department of Navy Large Aircraft Infrared Countermeasures (DoN LAIRCM) Program

Distributed Common Ground System – Marine Corps (DCGS-MC)

Distributed Common Ground System – Navy (DCGS-N)

E-2D Advanced Hawkeye

EA-18G – Airborne Electronic Attack Variant of the F/A-18 Aircraft

Enhanced Combat Helmet (ECH)

Evolved SeaSparrow Missile (ESSM)

Evolved SeaSparrow Missile Block 2

F/A-18E/F – Super Hornet Naval Strike Fighter

Future Pay and Personnel Management Solution (FPPS)

Global Combat Support System – Marine Corps (GCSS-MC)

Global Command and Control System – Maritime (GCCS-M)

Ground/Air Task Oriented Radar (G/ATOR)

Infrared Search and Track System

Integrated Defensive Electronic Countermeasures (IDECM) (All Blocks)

Joint and Allied Threat Awareness System (JATAS)

Joint Expeditionary Fires

Joint High Speed Vessel (JHSV)

Joint Precision Approach and Landing System (JPALS) Increment 1 (Ship system)

Joint Precision Approach and Landing System (JPALS) Increment 2 (Land system)

Joint Standoff Weapon C-1 Variant (JSOW C-1)

KC-130J with Harvest Hawk

Landing Ship Dock Replacement (LSD(X))

LHA 6 – *America* Class Amphibious Assault Ship – includes all supporting PARMs

LHD 8 Amphibious Assault Ship

Light Armored Vehicle (LAV)

Light Weight Tow Torpedo Countermeasure (part of LCS ASW Mission Module)

Littoral Combat Ship (LCS) – includes all supporting PARMs, and 57 mm lethality

Littoral Combat Ship (LCS) Mission Modules including 30 mm and missile lethality

Littoral Combat Ship (LCS) Surface-to-Surface Missile Module (follow-on to the interim Griffin Missile)

Littoral Combat Ship (LCS) Variable Depth Sonar (VDS)

Logistics Vehicle System Replacement

LPD-17 – *San Antonio* Class Amphibious Transport Dock Ship – includes all supporting PARMs and 30 mm lethality

Marine Personnel Carrier

Maritime Prepositioning Force (Future) Mobile Landing Platform

Mark XIIA Identification Friend or Foe (IFF) Mode 5 (all development and integration programs)

Medium Tactical Vehicle Replacement (MTV) Program (USMC)

NAVY PROGRAMS (continued)

Medium-Range Maritime Unmanned Aircraft System

MH-60R Multi-Mission Helicopter Upgrade

MH-60S Multi-Mission Combat Support Helicopter

Mine Resistant Ambush Protected (MRAP) Family of Vehicles (FoV) – including Special Operations Command vehicles

Mk 54 Torpedo/Mk 54 Vertical-Launch Anti-Submarine (VLA)/MK 54 Upgrades Including High-Altitude Anti-Submarine Warfare (ASW) Weapon Capability (HAAWC)

Mk 48 CBASS Torpedo

Mk 48 Torpedo Mods

Mobile User Objective System (MUOS)

Multi-static Active Coherent (MAC) System CNO project 1758

MV-22 Osprey – Joint Advanced Vertical Lift Aircraft

Naval Integrated Fire Control – Counter Air (NIFC-CA)

Navy Enterprise Resource Planning (ERP)

Navy Unmanned Carrier Launched Airborne Surveillance and Strike (UCLASS) System

Next Generation Enterprise Network (NGEN)

Next Generation Jammer (NGJ)

Offensive Anti-Surface Warfare

Offensive Anti-Surface Warfare Interim Capability (also called Tomahawk Offensive Anti-Surface Warfare Interim Capability)

Ohio Replacement Program (Sea-based Strategic Deterrence) – including all supporting PARMs

Organic Airborne and Surface Influence Sweep (OASIS)

P-8A Poseidon Program

Rapid Airborne Mine Clearance System (RAMICS)

Remote Minehunting System (RMS)

Replacement Oiler

Rolling Airframe Missile (RAM) including RAM Block 1A Helicopter Aircraft Surface (HAS) and RAM Block 2 Programs

Sea-Based Support to Special Forces

Ship Self-Defense System (SSDS)

Ship-to-Shore Connector (SSC)

Small Tactical Unmanned Aerial System (STUAS) – UAS Tier II

SSN 774 *Virginia* Class Submarine

SSN 784 *Virginia* Class Block III Submarine

Standard Missile-2 (SM-2) including all mods

Standard Missile-6 (SM-6)

Submarine Torpedo Defense System (Sub TDS) including countermeasures and Next Generation Countermeasure (NGCM) System

Surface Electronic Warfare Improvement Program (SEWIP) Block 2

Surface Electronic Warfare Improvement Program (SEWIP) Block 3

Surface Electronic Warfare Improvement Program (SEWIP) Block 4

Surface Mine Countermeasures Unmanned Undersea Vehicle (also called Knifefish UUV) (SMCM UUV)

Surveillance Towed Array Sonar System/Low Frequency Active (SURTASS/LFA) including Compact LFA (CLFA)

Tactical Tomahawk – Follow-on to Tomahawk Baseline Missile

T-AKE – *Lewis & Clark* Class of Auxiliary Dry Cargo Ships (T-AKE) – includes all supporting PARMs

Torpedo Warning System (Previously included with Surface Ship Torpedo Defense System) including all sensors and decision tools

Trident II Missile – Sea Launched Ballistic Missile

UH-1Y

Unmanned Influence Sweep System (UISS) include Unmanned Surface Vessel (USV) and Unmanned Surface Sweep System (US3)

Unmanned Undersea Vehicle Program

Vertical Take-off and Landing Tactical Unmanned Air Vehicle (VTUAV) (Fire Scout)

VXX – Presidential Helicopter Fleet Replacement Program

AIR FORCE PROGRAMS

20 mm PGU-28/B Replacement Combat Round

Advanced Extremely High Frequency (AEHF) Satellite Program

Advanced Medium Range Air-to-Air Missile (AMRAAM)

Advanced Pilot Trainer

Air Force Distributed Common Ground System (AF-DCGS)

Air Force Integrated Personnel and Pay System (AF-IPPS)

Air Force Intranet (AFNet) Combat Information Transport System (CITS) Migration Urgent Operational Need

Air Force Intranet (AFNet) Increment 1

Air Force Intranet (AFNet) Increment 2

Air Force Intranet (AFNet) Modernization capabilities (Bitlocker, Data at Rest , Situational Awareness Modernization)

Air Operations Center – Weapon System (AOC-WS) Initiatives 10.0 and 10.1

Air Operations Center – Weapon System (AOC-WS) Initiative 10.2

Airborne Signals Intelligence Payload (ASIP) Family of Sensors

Airborne Warning and Control System (AWACS) Block 40/45 Upgrade

ALR-69A Radar Warning Receiver

B-2 Advanced Extremely High Frequency (EHF) Satellite Communications (SATCOM) and Computer Capability Increment I

AIR FORCE PROGRAMS (continued)

B-2 Advanced Extremely High Frequency (EHF) Satellite Communications (SATCOM) and Computer Capability Increment II

B-2 Defensive Management System Modernization (DMS)

B-61 Mod 12 Life Extension Program

Battle Control System – Fixed (BCS-F) 3.1

Battle Control System – Fixed (BCS-F) 3.2

C-130 Aircraft Avionics Modernization Program (AMP)

C-130J – Hercules Cargo Aircraft Program

C-17A – Globemaster III Advanced Cargo Aircraft Program

C-27J Joint Cargo Aircraft (JCA)

C-5 Aircraft Avionics Modernization Program (AMP)

C-5 Aircraft Reliability Enhancement and Re-Engining Program (RERP)

C-5 Core Mission Computer and Weather Radar Replacement

Cobra Judy Replacement Mission Planning Tool

Command and Control Air Operations Suite (C2AOS)/Command and Control Information Services (C2IS) (Follow-on to Theater Battle Management Core Systems)

CV-22 Osprey – Joint Advanced Vertical Lift Aircraft

Defense Enterprise Accounting and Management System – Air Force (DEAMS – AF)

Enhanced Polar System (EPS)

Evolved Expendable Launch Vehicle

Expeditionary Combat Support System (ECSS)

F-15E Radar Modernization Program

F-22 – Raptor Advanced Tactical Fighter

F-35 – Lightning II Joint Strike Fighter (JSF) Program

Family of Beyond Line-of-Sight Terminals (FAB-T)

Family of Beyond Line-of-Sight Terminals (FAB-T), Increment 2 (High Data Rate Airborne Terminal)

Full Scale Aerial Target

Global Broadcast Service (GBS)

Global Broadcast Service (GBS) Defense Enterprise Computing Center (DECC)

Global Hawk (RQ-4B) Block 30 – High Altitude Endurance Unmanned Aircraft System

Global Hawk (RQ-4B) Block 40 – High Altitude Endurance Unmanned Aircraft System

Global Positioning Satellite (GPS) Next Generation Control Segment (OCX)

Global Positioning Satellite III (GPS-IIIA)

HC/MC-130 Recapitalization

HH-60G/CRH (Combat Rescue Helicopter)

Information Transport System (ITS) Increment 2

Integrated Strategic Planning and Analysis Network (ISPAN) Increment 2

Integrated Strategic Planning and Analysis Network (ISPAN) Increment 4

Joint Air-to-Surface Standoff Missile (JASSM) and JASSM – Extended Range (JASSM-ER))

Joint Direct Attack Munition (JDAM)

Joint Mission Planning Systems (JMPS) – Air Force (including RC-135, E-8/E-3, F-22, A-10)

Joint Space Communication Layer

Joint Space Operations Center (JSpOC) Mission System (JMS)

KC-46 – Tanker Replacement Program

Large Aircraft Infrared Countermeasures (LAIRCM) Program

Long Range Stand Off (LRSO) Weapon

Long Range Strike Bomber

Mark XIIA Identification Friend or Foe (IFF) Mode 5 (all development and integration programs)

Massive Ordnance Penetrator (MOP)

Military GPS User Equipment (MGUE)

Miniature Air-Launched Decoy (MALD)

Miniature Air-Launched Decoy – Jammer (MALD-J)

MQ-9 Reaper – Unmanned Aircraft System

MQ-X

Multi-Platform Radar Technology Insertion Program (MP RTIP)

Navstar Global Positioning System (GPS) (includes Satellites, Control, and User Equipment)

Nuclear Detection (NUDET) System (NDS)

Presidential Aircraft Recapitalization (PAR) Program – Air Force One Recapitalization Program

Small Diameter Bomb, Increment I

Small Diameter Bomb, Increment II

Space Fence (SF)

Space-Based Infrared System (SBIRS) Program, High Component

Space-Based Space Surveillance (SBSS) Block 10 Follow-on

Three-dimensional Expeditionary Long-Range Radar (3DELRR)

Vulnerability Lifecycle Management System (VLMS) 1.5

Weather Satellite Follow-on (WSF)

Wideband Global Satellite Communications (SATCOM) (WGS) Program

Problem Discovery Affecting Operational Test and Evaluation

One purpose of test and evaluation is to determine if thresholds in the approved Capability Production Document (CPD) have been satisfied. The Acquisition Executive needs this information in making production decisions, but satisfying these measures is often not equivalent to achieving the required combat capability needed for mission accomplishment. A comprehensive evaluation of operational effectiveness, operational suitability, and survivability provides the Acquisition Executive and operational users with information regarding a system's combat capability. This evaluation can only be done after operational testing (OT) under realistic combat conditions, which includes end-to-end testing with operational users across the intended operational envelope and within the context of the system-of-systems in which it will operate.

The Deputy Assistant Secretary of Defense (DASD) Developmental Test and Evaluation (DT&E) conducts an assessment of all Major Defense Acquisition Programs and special interest programs prior to their OT; this DT&E assessment reports on a system's demonstrated ability to meet its Key Performance Parameters and assesses the risk of the system's ability to successfully complete OT. The DT&E assessment is based on capabilities demonstrated during developmental testing (DT), early OT, and criteria from the Test and Evaluation Master Plan and requirements documents. The DT&E community engages with program offices early and often throughout a program's acquisition cycle, observing both contractor and government DT. The DT and early OT events provide the program manager opportunities to discover and correct problems that could prevent a system from delivering its required combat capability. As such, the test events should include as much operational realism as possible, and also include military operators and maintainers whenever possible. The early test events should also provide information to the requirements and resource sponsors for the system to ensure that the documented requirements are still relevant and feasible. By the time of the Initial Operational Test and Evaluation (IOT&E), discovery of significant issues affecting combat capability should be rare, and lingering problems from DT should have been resolved.

Last year, I added a new section to my Annual Report assessing systems under my oversight in 2010-2011 with regard to problem discovery during testing. My assessment fell into two categories: systems with significant issues observed in OT that should, in my view, have been discovered and resolved prior to the commencement of OT, and systems with significant issues observed during early testing that, if not corrected, could adversely affect my evaluation of those systems' effectiveness, suitability, and survivability during IOT&E. This year, I am providing an update to the status of those systems identified last year, as well as my assessment of systems under my oversight in 2012 within those two categories.

Last year, I reported that four of the seven Assessments of Operational Test Readiness (AOTRs) that I received from the DASD(DT&E) recommended that the programs not proceed to IOT&E, but that the program proceeded anyway. Regardless of the AOTR recommendation, six of those seven programs experienced significant issues in their IOT&Es: the C-5 Reliability Enhancement and Re-Engining Program (RERP); RQ-4B Global Hawk Blocks 20 and 30; Standard Missile-6 (SM-6); Multi-functional Information Distribution System (MIDS) Joint Tactical Radio System (JTRS); Stryker Nuclear, Biological, and Chemical Reconnaissance Vehicle (NBCRV); and Joint Tactical Radio System (JTRS) Handheld, Manpack, and Small Form Fit (HMS) Rifleman Radio.

I have received 12 additional assessments from DASD(DT&E) since my report last year; these are listed in the table below. Of the 12 reports, 2 recommended not proceeding to IOT&E: MQ-1C Gray Eagle and JTRS HMS Manpack Radio. Despite the recommendation, both of these systems proceeded to IOT&E. The JTRS HMS Manpack Radio performed poorly in the IOT&E, as predicted by the AOTR; however, the MQ-1C Gray Eagle performed well in IOT&E despite DT results suggesting poor reliability that would affect the test outcome. In fact, the Gray Eagle IOT&E demonstrated that the modeling assumptions that established the reliability requirements thresholds were not valid. As a result, the Army is reassessing whether those reliability thresholds should be changed. Additionally, as discussed in this section last year, the Warfighter Information Network – Tactical (WIN-T) Increment 2 had both performance and reliability issues during early testing, but these issues were not assessed by the DT&E AOTR. Two of the systems listed below are still in-test: P-8 and Joint Space Operations Center (JSpOC) Mission System (JMS) Increment 1.

DASD(DT&E) Assessments of Operational Test Readiness (AOTRs)	
AIM-9X Air-to-Air Missile Upgrade	Joint Space Operations Center (JSpOC) Mission Systems (JMS) Increment 1
Apache Block III	Joint Tactical Radio System (JTRS) Handheld, Manpack, and Small Form Fit (HMS) Manpack Radio
B-2 Extremely High Frequency (EHF)	MQ-1C Gray Eagle Unmanned Aircraft System (UAS)
C-130 Avionics Modernization Program (AMP)	P-8
E-2D Advanced Hawkeye	Space-Based Infrared System (SBIRS)
HC/MC-130J	Warfighter Information Network – Tactical (WIN-T) Increment 2

PROGRESS UPDATES ON DISCOVERIES REPORTED LAST YEAR

Last year, I identified 23 systems that had significant issues in early testing that should be corrected prior to IOT&E. The following table provides an update on the progress those systems made in implementing fixes to those problems.

FY11 DISCOVERIES IN EARLY TESTING THAT SHOULD BE CORRECTED PRIOR TO IOT&E			
Fixes Implemented and Demonstrated in OT	**Fixes Implemented; Currently in OT or Planning OT**	**Some Fixes Implemented; Testing Constrained Pending Future Acquisition Decisions**	**No Fixes Planned**
Apache Block III	Aegis Modernization	Joint Tactical Radio System (JTRS) Handheld, Manpack, and Small Form Fit (HMS) Manpack Radio	Defense Enterprise Accounting and Management System (DEAMS)
EProcurement	AIM-120 Advanced Medium-Range Air-to-Air Missile (AMRAAM)	RQ-4B Global Hawk Block 30 High-Altitude, Long-Endurance Unmanned Aerial System (UAS)	LHA-6
Joint Tactical Radio System (JTRS) Network Enterprise Domain (NED)	AN/TPQ-53 Radar (formerly the Enhanced AN/TPQ-36 Radar System (EQ-36))	Vertical Take-Off and Landing Unmanned Aerial Vehicle (VTUAV)	Littoral Combat Ship (LCS) Mission Modules
MQ-1C Gray Eagle Unmanned Aircraft System (UAS)	E-2D Advance Hawkeye		MQ-9 Reaper Armed Unmanned Aircraft System (UAS)
Spider XM7 Network Command Munition	Joint High Speed Vessel (JHSV)		
	Miniature Air-Launched Decoy – Jammer (MALD-J)		
	Mk 48 Advanced Capability (ADCAP) Mod 7 Common Broadband Advanced Sonar System (CBASS)		
	Mk 54 Lightweight Torpedo		
	P-8A Poseidon		
	Surveillance Towed Array Sensor System (SURTASS) with Compact Low Frequency Active (CLFA)		
	Warfighter Information Network – Tactical (WIN-T)		

Last year, I identified 17 systems that had significant issues in IOT&E that should have been discovered and resolved prior to commencement of operational testing. The following table provides an update on the status of those systems, as well as the progress those systems have made in implementing fixes to the problems.

FY11 DISCOVERIES IN IOT&E THAT SHOULD HAVE BEEN RESOLVED PRIOR TO OPERATIONAL TEST			
Fixes Implemented and Demonstrated in FOT&E	**Fixes Implemented; But New Issues Discovered**	**Fixes Implemented; Currently in OT**	**No Fixes Planned**
C-130J	AGM-88E Advanced Anti-Radiation Guided Missile (AARGM)	LPD-17	Force XXI Battle Command Brigade and Below (FBCB2) Joint Capabilities Release (JCR)
Common Aviation Command and Control System (CAC2S)	Standard Missile-6 (SM-6)	Nett Warrior	Stryker Nuclear, Biological, and Chemical Reconnaissance Vehicle (NBCRV)
CV-22 Osprey			Vertical Launch Anti-Submarine Rocket (VLA) with Mk 54 Mod 0 Lightweight Hybrid Torpedo
Department of the Navy (DoN) Large Aircraft Infrared Countermeasures (LAIRCM)			
Financial Information Resource System (FIRST)			
Multi-functional Information Distribution System (MIDS) Joint Tactical Radio System (JTRS)			
Navy Multiband Terminal (NMT)			
Space-Based Space Surveillance (SBSS)			
Additionally, 2 of 17 programs were cancelled: Early Infantry Brigade Combat Team (E-IBCT) and Joint Tactical Radio System (JTRS) Ground Mobile Radio (GMR).			

PROBLEMS DISCOVERED DURING OPERATIONAL TEST AND EVALUATION THAT SHOULD HAVE BEEN DISCOVERED DURING DEVELOPMENTAL TEST AND EVALUATION

SIGNIFICANT DISCOVERIES IN FY12 IOT&E	
AGM-88E Advanced Anti-Radiation Guided Missile (AARGM)	Key Management Infrastructure (KMI) Increment 2
ALR-69 Radar Warning Receiver (RWR)	Mine Resistant Ambush Protected (MRAP) Caiman Multi-Terrain Vehicle (CMTV)
Battle Control System – Fixed (BCS-F) Release 3.2	Mine Resistant Ambush Protected (MRAP) Dash Ambulance
Distributed Common Ground System – Army (DCGS-A)	Miniature Air-Launched Decoy – Jammer (MALD-J)
E-2D Advanced Hawkeye	MV-22 Osprey
E-3 Airborne Warning and Control System (AWACS) Block 40/45 Upgrade	Standard Missile-6 (SM-6)
Joint Mission Planning System – Air Force (JMPS-AF) Mission Planning Environment (MPE) E-8	*Virginia* Class Submarine Modernized with the APB-09 Acoustic Rapid Commercial Off-the-Shelf (COTS) Insertion (A-RCI) Sonar System and AN/BYG-1 Combat Control System
Joint Tactical Radio System (JTRS) Handheld, Manpack, and Small Form Fit (HMS) Manpack Radio	Warfighter Information Network – Tactical (WIN-T) Increment 2
Joint Tactical Radio System (JTRS) Handheld, Manpack, and Small Form Fit (HMS) Rifleman Radio	

AGM-88E Advanced Anti-Radiation Guided Missile (AARGM)

The AARGM program spent most of FY11 correcting hardware and software deficiencies discovered in DT and during its first IOT&E attempt. Once IOT&E began the second time, the Navy provided requirements changes in response to deficiencies identified since the first IOT&E attempt was terminated, and hence, the test scenarios were less stressing than originally planned. Additionally, new anomalies were discovered:

- AARGM Guidance Section/Control Section communication failures caused a significant number of operational mission failures. The problem occurred during specific IOT&E threat scenarios, but the system deficiency identified is one that should have been identified with adequate DT&E.
- A classified deficiency in performance required an adjusted threat representation.

ALR-69 Radar Warning Receiver (RWR)

The Air Force began operational flight testing in May 2012, knowing that the system would likely not meet several thresholds based on DT that occurred between February and May 2011. Additional deficiencies were observed in OT:

- Threat symbol splitting (when one threat signal received by the system produces multiple threat symbols at different azimuths on the cockpit display) degraded the aircrew's situational awareness as to which displayed threats are "real," where those real threats are located, and inhibited the aircrew's ability to appropriately react to the threat(s) in a timely manner. The threat symbol splitting deficiency did not occur during DT. The program believes it was strictly a software timing problem, and they modified the software and demonstrated the fix in the laboratory after the IOT&E. No flight testing has been accomplished to verify the fix.

Battle Control System – Fixed (BCS-F) Release 3.2

The Air Force conducted OT of BCS-F from April through August 2012, at the System Support Facility (SSF) and all four U.S. operational air defense sectors.

- A critical deficiency was discovered during OT at the Eastern Air Defense Sector. Random tracks were not being passed from the BCS-F system to the Joint Air Defense Operations Center at Bolling Air Force Base, Washington, D.C. This deficiency causes a loss of situational awareness for the operators conducting surveillance of the National Capital Region and results in an inaccurate air picture. The problem with the forwarding of tracks could not be identified at the

SSF during DT&E since the SSF cannot replicate sector link architecture.

Distributed Common Ground Station – Army (DCGS-A)

The Army conducted the DCGS-A Software Baseline 1.0 IOT&E from May through June 2012 at Fort Stewart, Georgia. DOT&E found the system not operationally effective, not operationally suitable, and not survivable because of deficiencies identified in the OT:

- Effective workflow is inhibited for the development of intelligence products to support operations because the system configuration as tested placed the fusion capability in the Secret Compartmented Information (SCI) (high) side even though most of the data necessary for fusion are in the Secret (low) side. Additionally, collection management tools are on the high side, but collection managers need to work closely with the brigade operations staff on the low side. Human intelligence tools are split between the high side and low side, but human intelligence analysts manage and interview their sources on the low side. Developmental testing and Early User Testing were conducted in a laboratory environment that did not replicate the physical separation and security barriers of the deployed configuration.
- The targeting software in the SCI enclave used first known location rather than the last known location. The DT showed the target algorithm to be correct, but was not robust enough to discover this deficiency.
- DCGS-A was not reliable because of a large number of software problems. The program has not rigorously tracked metrics identifying trends in software maturity, such as the number of new software problems opened and the number of software problems closed.

E-2D Advanced Hawkeye

The Navy conducted the E-2D IOT&E from February to September 2012. The evaluation is currently ongoing, but the following deficiencies were revealed:

- Cooperative Engagement Capability (CEC) software deficiencies associated with the CEC system generating multiple tracks for the same contact were outstanding upon entering IOT&E; thus, CEC was decoupled from the E-2D IOT&E. Corrections to the CEC system have continued throughout 2012. The system is now in test. It is likely that current E-2D fixes will not address all shortfalls in the current CEC system. Ongoing work is required, some of which is required for other systems separate from E-2D and CEC.
- Radar track re-labeling was observed in DT, but the full magnitude of the problem only manifested itself under the conditions of IOT&E.

E-3 Airborne Warning and Control System (AWACS) Block 40/45 Upgrade

The Air Force conducted a 24-flight IOT&E operating from the E-3 main operating base, Tinker Air Force Base, Oklahoma City, Oklahoma, between March and June 2012. The two operational Block 40/45 E-3 aircraft participated in several large force exercises. The test included flights working with assets from all four Services in training areas on both coasts as well as over land. The Block 40/45 AWACS was not ready to enter IOT&E, in addition to aircrews and maintainers not having representative training.

- The mission planning system and mission computing start-up checklist were never tested in DT&E and were used for the first time in IOT&E.
- The system was designed to the interoperability standards in place when the development contract was written. The aircraft does not provide Link 16 capabilities that are equivalent to the legacy Block 30/35 it replaces. Many of the tactical datalink deficiencies were caused by the Air Force not modifying the system design to reflect changes in interoperability standards during Block 40/45 development. The satellite communications terminal did not provide an operationally useful capability to receive digital information.

Joint Mission Planning System – Air Force (JMPS-AF) Mission Planning Environment (MPE) E-8

The Air Force paused the IOT&E of the E-8 MPE, the representative test platform for JMPS-AF Increment IV, in September 2011 to allow the Program Office to develop and integrate corrective actions to deficiencies identified during OT. Following additional development and regression testing, the Air Force certified E-8 MPE version 1.3 ready for resumed OT. The Air Force intends to re-execute the entire IOT&E in early FY13. DOT&E's assessment of the paused IOT&E noted significant deficiencies that were not identified during DT&E:

- The time needed for E-8 MPE software installation was lengthy, due in large part to anomalies in the software functionality and installation process
- Threat database information was not easily accessible or usable; training for intelligence specialists was inadequate
- Inability to transfer mission plans to the aircraft
- Critical calculation errors of the magnetic variation for user-specified waypoints
- Could not plan missions with in-flight delays

Joint Tactical Radio System (JTRS) Handheld, Manpack, and Small Form Fit (HMS) Manpack Radio

Although the DASD(DT&E) AOTR stated the Manpack radio was not sufficiently mature to enter the planned Multi-Service Operational Test and Evaluation (MOT&E), the Army proceeded to conduct the test as a part of the Network Integration Evaluation (NIE) 12.2. DOT&E assessed the Manpack as not operationally effective due to the poor performance of the Single Channel Ground and Airborne Radio System (SINCGARS) waveform and not operationally suitable due to a failure to meet reliability or availability requirements. The Manpack radio AOTR had outlined these major MOT&E deficiencies prior to OT. In September 2012, the Army conducted a Government Development Test (GDT) 3 to demonstrate improvements in

MOT&E deficiencies. During GDT 3, the Manpack radio demonstrated:

- Improved performance of the SINCGARS waveform that met requirements of mounted and dismounted transmission range, voice quality, and call completion rates under benign conditions of developmental test.
- Poor reliability with the Solider Radio Waveform (SRW) waveform demonstrating 177 hours Mean Time Between Essential Function Failure compared to the Manpack radio requirement of 477 hours. This translates to a 66 percent chance of completing a 72-hour mission compared to a requirement of 86 percent.

Joint Tactical Radio System (JTRS) Handheld, Manpack, and Small Form Fit (HMS) Rifleman Radio

From October to November 2011, the Army Test and Evaluation Command conducted the Rifleman Radio IOT&E at White Sands Missile Range, New Mexico, as part of the Army's NIE 12.1. Operational units tested the Rifleman Radio using the Soldier Radio Waveform Network Manager (SRWNM) to plan and load SRW network configurations into the radios. From February through March 2012, the Army conducted the Rifleman Radio GDT 2.3 at the Electronic Proving Ground at Fort Huachuca, Arizona. The Army conducted this GDT to complete DT that the Army should have completed prior to IOT&E. In April 2012, the Army conducted a follow-on developmental test, GDT 2.3a. The Army used this follow-on event to confirm fixes to deficiencies observed during GDT 2.3.

- The SRWNM was not employed with the Rifleman Radio prior to IOT&E. The poor performance of the SRWNM adversely affected the performance of the Rifleman Radio.
- The software version used in the Rifleman Radio for IOT&E was not the final version to include all the security features required by the National Security Agency (NSA) certification. The NSA requirements updated software caused numerous essential function failures during GDT 2.3, which followed IOT&E. GDT 2.3 reliability was so poor that the Army executed a GDT 2.3a to reassess DT reliability with installed security fixes. If the DT had been conducted prior to IOT&E, the Army would have produced a more reliable radio for operational test.
- Problems with reliability, range, battery life, and thermal characteristics were found in early OT.
- Prior to the IOT&E, problems with the communications security retention battery would have negatively affected suitability.
- Post-IOT&E, additional problems were found with the Rifleman Radio including spontaneous self-initiated shutdown, failures to transmit and receive, and the SRW network not healing in a timely manner after radios that had separated from the network rejoined. These deficiencies have been fixed and demonstrated in DT.
- All deficiencies have been shown to be fixed or improving (reliability still not met) but should still be confirmed in a formal GDT prior to the competitive IOT&E-2.

Key Management Infrastructure (KMI) Increment 2

The Joint Interoperability Test Command conducted an IOT&E from July until August 2012. The results were a marked improvement over previous operational assessments; however, there were still several operational effectiveness and suitability problems uncovered during the testing event that must be corrected before continued deployment. The KMI program and vendor regression testing of software was problematic and inconsistent. Lacking thorough regression, software fixes in newer releases often broke previously functioning components.

- OT identified some problems that were missed by DT, including problems with Electronic Key Management System (EKMS) to KMI transition, High Assurance Internet Protocol Encryptor (KG-250) configuration, virtual private network establishment, and data error handling. The developmental test environment was initially limited because of no operational data from the legacy system; however, this has now been corrected.
- The transition process from EKMS to KMI functioned in DT, but was inadequate once implemented in the operational environment on live networks. The controlled test environment did not account for multiple network configuration; and therefore, the test team was forced to perform rapid diagnosis, on-the-fly troubleshooting, and resolution as the OT&E was underway.

Mine Resistant Ambush Protected (MRAP) Caiman Multi-Terrain Vehicle (CMTV)

Another major capability insertion during FY12 included the Independent Suspension System for the CMTV. Endurance testing of the CMTV is ongoing at Yuma Proving Ground, Arizona, in all conditions.

- Based on performance during DT, the CMTV cannot stop following sustained operations in muddy terrain. The program suspended DT until the program identifies and implements a materiel solution to fix the brake system.
- The CMTV experienced problems associated with air conditioner, tire, and cab mount cracking failures.

Mine Resistant Ambush Protected (MRAP) Dash Ambulance

The MRAP program continues to acquire and test enhanced capabilities to integrate across the MRAP family of vehicles. In FY12, a major capability insertion included the ambulance kits for the Navistar Dash. The Dash Ambulance is not operationally effective and not operationally suitable because of the deficiencies listed below:

- The patient compartment of the vehicle is small and the litter births are not long enough to safely accommodate litter patients taller than 5 feet 11 inches. A unit equipped with the Dash Ambulance cannot provide safe emergency medical care and transport for tall casualties in close proximity to enemy forces. This problem should have been corrected prior to the Limited User Test (LUT).
- The small interior of the Dash Ambulance does not provide sufficient space for medical equipment and inhibits the ability

of the medic to maneuver within the compartment to properly treat patients.

Miniature Air-Launched Decoy (MALD) and Jammer (MALD-J)
The MALD variant (without the jammer) completed IOT&E in 2011 and was found operationally effective for combat, but not operationally suitable due to poor materiel reliability. In July 2011, the Air Force identified a fault with the missile's radio frequency connector that caused it to separate from the missile during long-endurance carriage flights. The Air Force has repaired the fault and conducted further reliability testing; however, MALD's operational reliability of 78 percent remains below the 93 percent threshold requirement. The Air Force began IOT&E for the MALD-J variant in August 2012.

MV-22 Osprey
The Navy conducted Follow-On Operational Test and Evaluation (FOT&E) in June 2012 of the latest Block C software and six other minor enhancements.

- The Traffic Advisory System (TAS) became saturated during formation flight, preventing the display of potentially hazardous traffic external to the mission aircraft. Intended to warn pilots of impending collision with approaching aircraft, the TAS does not distinguish between approaching aircraft and aircraft in formation. Additional development is needed to address operational test findings and improve the utility of TAS for the MV-22 fleet.

Standard Missile-6 (SM-6)
The Navy completed SM-6 Phase 2 IOT&E in July 2012. Phase 2 was an extensive modeling and simulation effort that examined SM-6 battlespace not covered in the flight tests completed in July 2011. As discussed last year, there were two classified performance anomalies in the flight test portion of the IOT&E that a more rigorous DT&E should have discovered earlier.

- The Phase 2 modeling and simulation trials confirmed the classified performance deficiency observed in flight test. The Navy is exploring corrective actions; however, implementation and testing of these corrective actions are not scheduled.
- The uplink/downlink antenna debris anomaly was discovered during DT and carried forward to IOT&E without corrective action being fully implemented on all missiles; thus, there were additional occurrences during IOT&E. The Navy conducted high-temperature wind tunnel tests, which examined if changes to the antenna sealant material and insulation bonding manufacturing process would eliminate the debris. The trials recorded no anomalies against these fixes; however, the unexpected discovery of insulation inter-layer delamination on three of five wind tunnel test articles raises questions regarding the efficacy of the Navy's corrective actions.
- First observed in DT, the Mk 54 Safe-Arm Device anomaly carried forward into IOT&E with additional occurrences. While initially viewed as anomalous, there is not enough evidence at this time to determine whether the Mk 54 behavior, as seen in testing, has a connection to the burst mode of the SM-6. However, the Phase 2 modeling and simulation trials confirmed that the missile lethality is sensitive to the combination of the burst mode, target, and engagement conditions.

***Virginia* Class Submarine Modernized with the APB-09 Acoustic Rapid Commercial Off-the Shelf (COTS) Insertion (A-RCI) Sonar System and AN/BYG-1 Combat Control System**

- A series of *Virginia* class FOT&E events examined the mission performance changes as a result of the modernization of the sonar and combat control system. These tests were combined with the operational evaluations of the latest variants of the A-RCI Sonar System, the AN/BYG-1 Combat Control System, and the Mk 48 Advanced Capability torpedo. One of the primary focus areas of the new combat control system software was the improvement of the Wide Aperture Array's processing and displays for the operators.
- The Wide Aperture Array demonstrated poor performance during the OT period, and operators chose not to use it to aid in completing their missions. The Navy investigated the problems after the OT period was complete, developed new software fixes, and fielded the new software following some limited DT. No OT has been completed to evaluate the new software or the effects on mission performance.
- These problems are recurring and likely a result of the Navy's time-based process for upgrading electronics systems.
- Many other systems on the *Virginia* class submarine exhibited the same failure modes in FOT&E as in IOT&E.

Warfighter Information Network – Tactical (WIN-T) Increment 2
In May 2012, the Army conducted the WIN-T Increment 2 IOT&E at Fort Bliss, Texas; White Sands Missile Range, New Mexico; Fort Campbell, Kentucky; Fort Riley, Kansas; and Fort Gordon, Georgia. DOT&E assessed the WIN-T Increment 2 as supportive of voice, video, and data communications at-the-halt and on-the-move. However, the network needs improvement in the following areas:

- Reliability
- Stability of the terrestrial Highband Networking Waveform network to support on-the-move communications
- Performance of the Soldier Network Extension
- Information Assurance

PROBLEMS DISCOVERED DURING EARLY TESTING THAT, IF NOT CORRECTED, COULD ADVERSELY AFFECT MY ASSESSMENT OF OPERATIONAL EFFECTIVENESS, SUITABILITY, AND SURVIVABILITY DURING INITIAL OPERATIONAL TEST AND EVALUATION (CONDUCTED WITHIN THE NEXT TWO YEARS)

DISCOVERIES IN EARLY TESTING IN FY12 THAT SHOULD BE CORRECTED PRIOR TO IOT&E	
Bradley Engineering Change Proposal (ECP)	Littoral Combat Ship (LCS) Increment 2
F-15E Radar Modernization Program (RMP)	Multi-Static Active Coherent (MAC) System
Joint Standoff Weapon (JSOW) C-1	Patriot Advanced Capability-3 (PAC-3)

Bradley Engineering Change Proposal (ECP)

In September 2012, the Army conducted two underbody blast tests at the Aberdeen Test Center on the M2A3 Infantry Fighting Vehicle with ECP1 components to characterize the system's vulnerability.

- Severe vehicle and occupant vulnerabilities were observed during early testing. If these vulnerabilities are not corrected the system will likely be assessed as not survivable against realistic underbody threats.

F-15E Radar Modernization Program (RMP)

F-15E RMP developmental flight testing began in January 2011 and IOT&E was expected to begin in late FY12. The planned FY12 IOT&E start did not occur due to challenges in maturing system software to meet the user's functional requirements.

- Software stability is crucial to operational effectiveness and suitability. However, the program experienced software maturation challenges and was unable to complete DT in 2012. Unanticipated software performance shortfalls led to multiple radar software releases and associated regression testing to mature radar mode functionality. At the end of FY12, RMP performance had not yet met the user's requirements. Achieving the Air Force RMP software stability requirement by IOT&E may not be feasible.

Joint Standoff Weapon (JSOW) C-1

The Navy completed DT and initiated integrated testing of the AGM-154C-1 JSOW variant during FY12. The JSOW C-1 integrated testing completed in early FY13, with OT to begin in mid-FY13.

- JSOW C-1 reliability is well below the threshold primarily because of software-driven problems. Achieving an adequate assessment of Mean Flight Hour between Operational Mission Failure during OT is an area of high risk.
- The pilot-vehicle interface is excessively complicated and could prevent successful mission execution.

Littoral Combat Ship (LCS)

The Navy conducted shore-based testing of the MH-60S Block 2 Airborne Mine Countermeasures System, which is intended to support LCS mine countermeasures. Additionally, the Navy commenced a Quick Reaction Assessment (QRA) of the gun systems on LCS 1. Testing indicated shortfalls in performance:

- The Navy determined the MH-60S helicopter cannot safely tow the AN/AQS-20A Sonar Mine Detecting Set (AQS-20A) or the Organic Airborne Sweep and Influence System because the helicopter is underpowered for these operations. The MH-60S helicopter will no longer be assigned these missions operating from any ship, including LCS.
- Preliminary evaluation of test data collected during the operational assessment (OA) of the MH-60S Block 2 Airborne Laser Mine Detection System indicates that the system does not meet Navy requirements for False Classification Density and has low reliability.
- Results from the QRA of the LCS gun systems revealed performance, reliability, and operator training deficiencies for both the 30 mm and 57 mm guns.

Multi-Static Active Coherent (MAC) System

The Navy conducted DT in 2012 and plans to begin OT in early FY13.

- No significant problems have been observed in DT to date; however, little realistic DT has been conducted, and the test construct used for DT contained target requirements that may support model verification but were not operationally realistic or translatable to operationally realistic conditions. The Navy plans to waive two known problems that will likely affect mission performance.

Patriot Advanced Capability-3 (PAC-3)

The Army completed DT of the Post-Deployment Build-7 (PDB-7) and began a LUT operational test in FY12.

- Data analysis is ongoing, but preliminary results indicate that Patriot training remains inadequate to prepare operators for complex Patriot engagements. This was true during the PDB-6.5 and PDB-6 LUTs as well. This problem was exacerbated in the PDB-7 LUT because many of the experienced Patriot operators in the test unit were understandably transferred to deploying units prior to the LUT, resulting in many inexperienced users and a high variability in Soldier proficiency across the test unit.

- The Patriot system did not meet its reliability requirements during the PDB-7 DT. DOT&E is investigating the possibility of using field data to improve the estimates of Patriot system reliability such as Mean Time Between Critical Mission Failure. However, critical field data including total operating hours and numbers of critical mission failures for each Patriot battery major end item may not be accurate.

CONCLUSION

Previously, Congress has expressed concerns that significant weapons acquisition program problems are discovered during OT&E that should have been discovered during DT. Last year, I documented 40 systems with significant discovery during OT during 2010-2011; 23 of those systems had discovery in early OT, of which 19 implemented fixes that were either verified by successful IOT&E or are currently in IOT&E. Of the 17 programs that discovered significant issues during their IOT&E in 2010-2011, 12 have implemented fixes that were either verified in successful FOT&E or are planning additional OT periods; 2 of the remaining 5 programs were cancelled. Thus, while significant issues are being discovered late in the programs' acquisition cycle, most programs are addressing the discoveries and verifying fixes in FOT&E. In 2012, 17 programs had significant discoveries in IOT&E or FOT&E, while 7 programs had significant discovery in early testing.

DoD Programs

DoD Programs

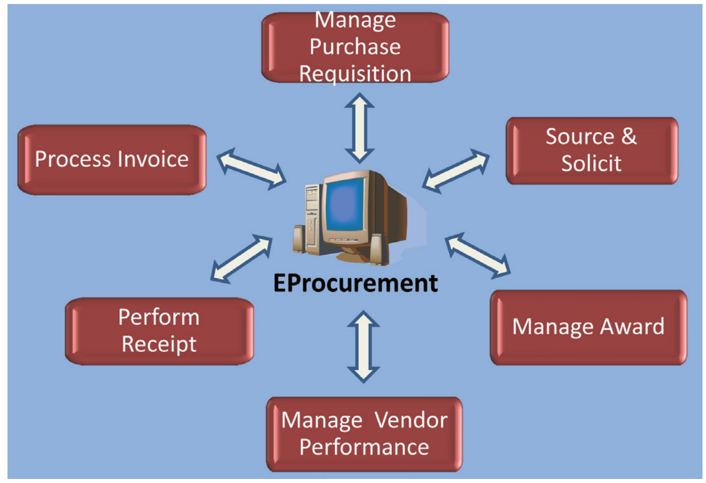
EProcurement

Executive Summary

- The Joint Interoperability Test Command (JITC) conducted a DOT&E-directed Operational Assessment (OA) of Release 1.2 in January 2012. EProcurement demonstrated significantly improved maturity over the previous Release 1.1. Users could successfully employ the system to execute all phases of procurement mission tasks with few problems. However, user perception of training adequacy, system usability, and system timeliness remained poor.
- JITC conducted the IOT&E of Release 1.2 between February and April 2012.
- EProcurement is operationally effective. The effectiveness evaluation concentrated on the users' ability to use EProcurement in six areas: manage purchase requisitions, source and solicit goods and services, manage awards, process receipts and invoices, create reports, and maintain system data (data cleansing and conversions). JITC observed users performing day-to-day operations and recorded 1,350 successful transactions and 13 failed transactions (99 percent success rate).
- EProcurement is operationally suitable, but with deficiencies. Improvements are required in the areas of training, usability, Help Desk operations, and supportability.
- EProcurement is secure from an Information Assurance perspective. At the end of IOT&E, only one moderate impact, and two low impact deficiencies remained open, with minimal effect on system security and operations. The Defense Information Systems Agency (DISA) and the Defense Logistics Agency (DLA) created a plan of action and milestones to address resolution of these deficiencies. However, DOT&E was unable to verify that DLA has a robust theft and fraud prevention and detection program.
- The Deputy Chief Management Officer (DCMO) approved the Full Deployment Decision (FDD) of EProcurement on August 23, 2012. As a part of the FDD approval, DLA agreed to employ a Red Team to conduct a pilot assessment in accordance with the rules of engagement established by the results of the DCMO-sponsored Massachusetts Institute of Technology Theft/Fraud Red Team study. DLA also agreed to continue the effort to demonstrate automated regression testing as a potential standard model for the DoD.

System

- DLA developed EProcurement to provide enterprise-level procurement capabilities to replace legacy procurement systems (Pre-Award Contracting System, Electronic Contract Folder, Procurement Automated Contract Evaluation, and Base Operations Support System).



- The Intended functions of EProcurement include: manage purchase requisition, source and solicit, manage award, manage vendor performance, perform receipt, and process invoice. Receipts and invoices are processed via the DLA Wide Area Workflow System or manually.
- EProcurement is based on a suite of commercial off-the-shelf (COTS) software applications purchased from the Systems Applications and Products Corporation that operates on COTS computing hardware.
- The Defense Enterprise Computing Center (DECC) in Ogden, Utah, which is operated and maintained by DISA, is the production environment for EProcurement. EProcurement is one of the programs in the overall DLA Enterprise Business System Infrastructure hosted by the Ogden DECC. The back-up site is located at the DECC in Mechanicsburg, Pennsylvania.

Mission

DLA users will use EProcurement to procure and provide the full spectrum of consumables, services, and depot-level repairables to the Army, Navy, Air Force, Marine Corps, other federal agencies, and combined and allied forces.

Major Contractor

Accenture – Reston, Virginia

Activity

- JITC conducted an OA of Release 1.2 in January 2012, in accordance with a DOT&E-approved OA plan. JITC conducted the OA at the DLA Aviation facility in Richmond, Virginia.
- JITC conducted the IOT&E of EProcurement Release 1.2 from February through April 2012. JITC executed the test at DLA locations in New Cumberland, Pennsylvania; Mechanicsburg, Pennsylvania; Battle Creek, Michigan; Fort Belvoir, Virginia; and Richmond, Virginia, in accordance with a DOT&E-approved IOT&E plan.
- Information Assurance testers from JITC along with members of the DISA Field Security Operations (FSO) and DLA Computer Emergency Response Team (CERT) conducted penetration test events at the DECC in Ogden, Utah, during both the OA and IOT&E.

Assessment

- During the Release 1.2 OA, EProcurement demonstrated significantly improved maturity over the previous Release 1.1. Users successfully used the system to execute all phases of procurement mission tasks with few problems. However, user training, system usability, and system timeliness still require improvement.
- Based on the IOT&E results, EProcurement is operationally effective.
  - The effectiveness evaluation concentrated on the users' ability to use EProcurement to: manage purchase requisitions, source and solicit goods and services, manage awards, process receipts and invoices, create reports, and maintain system data (data cleansing and conversions), which included all major system functionality.
  - JITC observed users performing day-to-day operations and recorded 1,350 successful transactions and 13 failed transactions, which achieved a 99 percent success rate and exceeded the 90 percent requirement.
  - EProcurement is interoperable. JITC interoperability testers evaluated 52 interfaces to assess the data exchanges between EProcurement and other systems, with no failures reported in the more than 400 transactions evaluated.
- EProcurement is operationally suitable but has deficiencies in the areas of training, usability, Help Desk operations, and supportability.
  - DOT&E considers EProcurement reliable, available, and maintainable. DLA reported one site specific outage at Battle Creek, Michigan, lasting 1 hour and 55 minutes, but it appears to have been an isolated event.
  - EProcurement training, training aids, and system documentation need improvement. None of these areas met the 80 percent threshold of acceptability by the users surveyed. Users report that EProcurement is not user friendly and is difficult to master.
  - Help Desk trouble tickets take a long time to resolve. Analysis of the closure rates for the tickets shows that the average time required to resolve trouble tickets was approximately 8.5 days, with resolution times ranging from less than 5 minutes to nearly 40 days.
  - The supportability of EProcurement needs improvement as DLA does not have an automated test capability to perform thorough regression testing on new software releases.
- EProcurement meets Information Assurance security thresholds. JITC Information Assurance testers, along with members of the DISA FSO and DLA CERT, conducted a series of penetration test events primarily at the Ogden DECC.
  - Following IOT&E, only one moderate impact, and two low impact deficiencies remained open, with minimal effect on system security and operations. DISA and DLA created a plan of action and milestones to address resolution of these deficiencies.
  - DLA did not implement a robust theft and fraud prevention and detection program. DLA asserts that by using role separations, at least two to three people would need to be involved in any theft or fraud activity and that while large-scale theft or fraud was not impossible, it would be difficult. DLA also indicated that bi-annual audits and other accounting controls are in place to further mitigate such activities. While DOT&E acknowledges that some level of prevention and detection is available at DLA, the extent of the financial threat vulnerability is yet to be determined and is pending the outcome of a financial theft and fraud test.

Recommendations

- Status of Previous Recommendations. The program manager satisfactorily addressed three of the five FY11 recommendations. The program manager partially addressed recommendations concerning operational realism of developmental testing and the use of automated test tools; these recommendations remain valid.
- FY12 Recommendations.
  1. DLA should employ a Theft and Fraud Prevention and Detection Red Team to conduct a pilot assessment in accordance with the rules of engagement established by the results of the Deputy Chief Management Officer-sponsored Theft and Fraud Red Team study.
  2. DLA should continue with ongoing efforts to implement automated regression testing.
  3. DLA should improve the quality of training, training aids, and other system documentation for the users, and include role-specific training in the future when DLA transitions users to EProcurement at the remaining DLA sites.
  4. DLA should modify the method of managing trouble tickets to allow for better query capabilities. DLA should also periodically track the resolution times of system problems to aid DLA management in identifying potential problem areas so that DLA can implement mitigation strategies before productivity is affected.
  5. DLA should periodically administer the System Usability Scale survey to a random sample of all EProcurement users

through full deployment to see whether user satisfaction does improve with increased system use and to pinpoint any inherent deficiencies with system usability.

6. In future testing, JITC and DLA should evaluate all untested interfaces that will be part of the full deployment.
7. Although only minor deficiencies remained after the last Information Assurance test event, the DISA FSO and DLA CERT should periodically reevaluate the security posture of the system as part of the overall defense-in-depth security strategy.

F-35 Joint Strike Fighter (JSF)

Executive Summary

- The F-35 Joint Strike Fighter (JSF) program continues to have a high level of concurrency among production, development, and test. Approximately 34 percent of the total planned flight testing, based on test points completed through November 2012, has now been accomplished as the program initiates the fifth of 11 initial production lots. Durability testing is ongoing on all three variants, with only the F-35A test article having completed a full lifetime of testing. The program will not complete the two lifetimes of durability testing currently planned on any variant until the last quarter of 2014.
- Through November 2012, the flight test teams were able to exceed the flight rate planned for flight sciences in the F-35B and F-35C variants, but were slightly behind the plan for the F-35A. The program did not accomplish the intended progress in achieving test objectives (measured in flight test points planned for 2012) for all variants. Certain test conditions were unachievable due to unresolved problems and new discoveries. The need for regression testing of fixes (repeat testing of previously accomplished points with newer versions of software) displaced opportunities to meet flight test objectives.
- The flight rate of the mission systems test aircraft also exceeded the planned rate during the year, but overall progress in mission systems was limited. This was due to delays in software delivery, limited capability in the software when delivered, and regression testing of multiple software versions (required to fix problems, not add capability). Test points accomplished for the year included Block 1 verification, validation of limited capabilities for early lot production aircraft, baseline signature testing, and Block 2 development. No combat capability has been fielded.
- The lag in accomplishing the intended 2012 flight testing content defers testing to following years, and in the meantime, will contribute to the program delivering less capability in production aircraft in the near term.
- The tables on the following page present the actual versus planned test flights and test points conducted as of the end of November 2012.
- The program submitted Revision 4 of the Test and Evaluation Master Plan (TEMP) for approval, which included changes to the program structure brought about by the previous year's Technical Baseline Review and subsequent re-planning of testing. However, the TEMP contained an unacceptable overlap of development with the start of operational test activity for IOT&E.
- The Air Force began the F-35A training Operational Utility Evaluation (OUE) in September 2012 and completed it in mid-November. During the OUE, four pilots completed training in the system familiarization portion of the syllabus, which included no combat capabilities. Because of the immaturity of the system, which is still largely under development, little can be learned about operating and sustaining the F-35 in combat operations from this evaluation.
- The program completed two of the eight planned system-level ballistic test series.
  - The first series confirmed the built-in redundancies and reconfiguration capabilities of the flight-critical systems. The second series indicated that ballistic damage introduced no measurable degradation in the F-35B propulsion system performance and that the damage would be undetectable by the pilot. Ongoing analysis will evaluate whether these tests stressed the vulnerabilities unique to ballistic damage to the F-35 (e.g., interference or arcing between 270 Volt, 28 Volt, and signal lines and/or damage to lift fan blade sections).
  - The first test series confirmed Polyalphaolefin (PAO) coolant and fueldraulic systems fire vulnerabilities. The relevant protective systems were removed from the aircraft in 2008 as part of a weight reduction effort. A Computation of Vulnerable Area Tool analysis shows that the removal of these systems results in a 25 percent increase in aircraft vulnerability. The F-35 Program Office may consider reinstalling the PAO shutoff valve feature based on a more detailed cost-benefit assessment. Fueldraulic system protection is not being reconsidered for the F-35 design.
- The program's most recent vulnerability assessment showed that the removal of fueldraulic fuses, the PAO shutoff valve,

and the dry bay fire suppression, also removed in 2008, results in the F-35 not meeting the Operational Requirements Document (ORD) requirement to have a vulnerability posture better than analogous legacy aircraft.
- Tests of the fuel tank inerting system in 2009 identified deficiencies in maintaining the required lower fuel tank oxygen levels to prevent fuel tank explosions. The system is not able to maintain fuel tank inerting through some critical portions of a simulated mission profile. The program is redesigning the On-Board Inert Gas Generating System (OBIGGS) to provide the required levels of protection from threat and from fuel tank explosions induced by lightning.

Actual versus Planned Test Metrics through November 2012

TEST FLIGHTS					
	All Testing	Flight Sciences			Mission Systems
	All Variants	F-35B Only	F-35A Only	F-35C Only	
2012 Actual	1,092	374	263	233	222
2012 Planned	927	244	279	211	193
Difference from Planned	+18%	+53%	–6%	+10%	+15%
Cumulative Actual	2,533	963	709	425	436
Cumulative Planned	2,238	820	651	404	363
Difference from Planned	+13%	+17%	+9%	+5%	+20%

TEST POINTS								
	All Testing	Flight Sciences			Mission Systems			
	All Variants	F-35B Only	F-35A Only	F-35C Only	Block 1*	Block 2	Block 3	Other
2012 Baseline Accomplished	4,711	1,075	1,338	1,060	358	457	0	423
2012 Baseline Planned	6,497	1,939	1,923	1,327	336	448	0	524
Difference from Planned	–28%	–45%	–30%	–20%	+7%	+2%	0	–19%
Added Points	1,720	292	565	253	0	610	0	0
Points from Future Year Plans	2,319	992	431	896	0	0	0	0
Total Points Accomplished**	8,750	2,359	2,334	2,209	358	1,067	0	423
Cumulative SDD Actual***	20,006	7,480	5,664	4,330	899	457	0	1,176
Cumulative SDD Planned	19,134	7,057	6,102	3,748	667	488	0	1,072
Difference from Planned	+5%	+6%	–7%	+16%	+35%	–6%		+10%
Test Points Remaining	39,579	12,508	8,321	10,316	8,434 (All Blocks and Other Mission Systems Activity)			

* Includes Block 0.5 and Block 1 quantities
** Total Points Accomplished = 2012 Baseline Accomplished + Added Points + Points from Future Year Plans
*** SDD – System Design and Development

System
- The F-35 JSF program is a tri-Service, multi-national, single-seat, single-engine family of strike aircraft consisting of three variants:
  - F-35A Conventional Take-Off and Landing (CTOL)
  - F-35B Short Take-Off/Vertical-Landing (STOVL)
  - F-35C Aircraft Carrier Variant (CV)
- It is designed to survive in an advanced threat (year 2012 and beyond) environment using numerous advanced capabilities. It is also designed to have improved lethality in this environment compared to legacy multi-role aircraft.
- Using an Active Electronically Scanned Array (AESA) radar and other sensors, the F-35 is intended to employ precision-guided bombs such as the Joint Direct Attack Munition (JDAM) and Joint Standoff Weapon, AIM-120C radar-guided Advanced Medium-Range Air-to-Air Missile (AMRAAM), and AIM-9 infrared-guided short-range air-to-air missile.
- The program provides mission capability in three increments: Block 1 (initial training), Block 2 (advanced), and Block 3 (full).
- The F-35 is under development by a partnership of countries: the United States, Great Britain, Italy, the Netherlands, Turkey, Canada, Australia, Denmark, and Norway.

Mission
- A force equipped with F-35 units should permit the Combatant Commander to attack targets day or night, in all weather, and in highly defended areas of joint operations.
- F-35 will be used to attack fixed and mobile land targets, enemy surface units at-sea, and air threats, including advanced cruise missiles.

Major Contractor

Lockheed Martin, Aeronautics Division – Fort Worth, Texas

Test Strategy, Planning, and Resourcing

- The JSF Program Office, in coordination with the operational test agencies, worked to develop Revision 4 of the TEMP. As part of the Milestone B recertification in March 2012, the USD(AT&L) tasked the program to submit a revised TEMP for approval prior to the September In-Progress Review by the Defense Acquisition Board.
- The TEMP included a schedule for IOT&E that assumed the final preparation period prior to IOT&E could fully overlap with the air-worthiness certification phase of development, which occurs after the final developmental test events. DOT&E identified to the program and the JSF Operational Test Team that without analysis showing this overlap is feasible, the TEMP could not be approved. DOT&E concluded that this final preparation period should be scheduled to begin at a later point, no earlier than the Operational Test Readiness Review, and budgets should be adjusted accordingly.
- This report reviews the program by analyzing the progress of testing and the capability delivered as a function of test results. The program plans a specific set of test points (discrete measurements of performance under specific test conditions) for accomplishment in a given calendar year. In this report, test points planned for a given calendar year are referred to as baseline test points. In addition to baseline test points, the program accomplishes test points added for discovery and regression. Cumulative System Design and Development (SDD) test point data refer to the total progress towards completing development at the end of SDD.

F-35A Flight Sciences

Flight Test Activity with AF-1, AF-2, and AF-4 Test Aircraft

- F-35A flight sciences testing focused on:
  - Expanding the flight envelope (achieved 700 knots calibrated airspeed [KCAS]/1.6 Mach test point in March and achieved 50,000 feet, the designed altitude limit, in November)
  - Evaluating flying qualities with internal stores (GBU-31 JDAM, GBU-12 Laser-guided Bomb, and AIM-120 AMRAAM) and external stores (AIM-9X short-range missile)
  - Characterizing subsonic and supersonic weapons bay door and environment
  - Expanding the air-refueling envelope and investigating tanker-to-F-35A connection/disconnection problems
  - Engine air-start testing
  - High (greater than 20 degrees) angle-of-attack testing
- The test team began weapons separation testing in October with the first safe separation of an inert GBU-31 JDAM, followed by the first AIM-120 safe separation later in the month.
- The program released two revisions of the air vehicle systems software (R27.1 and R27.2.2) in 2012 to improve flying qualities, correct air data deficiencies observed during F-35A envelope expansion, and to address various software deficiencies.
- Through the end of November 2012, the test team was able to sustain a sortie rate of 8.0 flights per aircraft per month, compared to the goal of 8.5 sorties per month. The overall annual sortie total was only 6 percent short of the goal (263 sorties completed, 279 planned).

Flight Sciences Assessment

- By the end of November, the progress against planned baseline test points for 2012 lagged by over 30 percent (accomplishing 1,338 baseline F-35A flight sciences test points of 1,923 planned through November 2012, for a completion rate of 70 percent). The test team could not execute this portion (30 percent) of planned 2012 baseline test points for the following reasons:
  - Aircraft operating limitations, which prevented the extended use of afterburner needed to complete high-altitude/high-airspeed test points.
  - Higher than expected loads on the weapon bay doors, which required additional testing and thus limited the amount of testing with weapons loaded on the aircraft.
  - Deficiencies in the air-refueling system, which reduced testing opportunities.
- To compensate for not being able to achieve the baseline test points planned for 2012, the test team moved up test points planned for completion in later years, and was thereby able to nearly keep pace with overall cumulative SDD test point objectives. For example, the Block 2B flight envelope includes operations with the weapons bay doors open. The program discovered dynamic flight loads on portions of the open doors were higher than expected, requiring additional instrumentation and testing. The test team substituted other test points, which were available from Block 3 envelope plans for 2013 that did not require the doors open. For F-35A flight sciences, the test team had accomplished 93 percent of the overall planned number of cumulative test points scheduled for completion by the end of November (5,664 cumulative points accomplished against a goal of 6,102 points).
- Weight management of the F-35A variant is important for meeting air vehicle performance requirements. The program generates monthly aircraft weight status reports for all variants and computes weights as a sum of measured weights of components or subassemblies, calculated weights from approved design drawings released for build, and engineering weight estimates of remaining components. The program has managed to keep F-35A weight estimates nearly constant for the last year. The latest F-35A weight status report from November 2012 showed the estimated weight of 29,098 pounds to be within 273 pounds (0.94 percent) of the projected maximum weight needed to meet the technical performance required per contract

specifications in January 2015. This small margin allows for only 0.42 percent weight growth per year for the F-35A. The program will need to continue rigorous weight management through the end of SDD to avoid performance degradation and operational impacts.

- The program announced an intention to change performance specifications for the F-35A, reducing turn performance from 5.3 to 4.6 sustained g's and extending the time for acceleration from 0.8 Mach to 1.2 Mach by 8 seconds. These changes were due to the results of air vehicle performance and flying qualities evaluations.
- Discoveries included:
  - Delayed disconnects during air refueling required the program to implement restrictions on the F-35A fleet and conduct additional testing of the air refueling capability. The program added instrumentation to isolate root causes.
  - Horizontal tail surfaces are experiencing higher than expected temperatures during sustained high-speed/high-altitude flight, resulting in delamination and scorching of the surface coatings and structure. All variants were restricted from operations outside of a reduced envelope until the test team added instrumentation to the tailbooms to monitor temperatures on the tail surfaces. The program scheduled modification of one flight sciences aircraft of each variant with new skin coatings on the horizontal tail to permit flight testing in the currently restricted part of the high-speed/high-altitude flight envelope. The test team is adding more flight test instrumentation to help quantify the impacts of the tail heating to support necessary design changes. The program scheduled modifications on one aircraft (AF-2) to be completed in early 2013 to allow flight testing of the new skin design on the horizontal tails to proceed.

F-35B Flight Sciences

Flight Test Activity with BF-1, BF-2, BF-3, BF-4, and BF-5 Test Aircraft

- F-35B flight sciences focused on:
  - Expansion of the vertical-lift operations envelope testing of the newly designed auxiliary air inlet door
  - Engine air-start testing
  - Expansion of the flight envelope with weapons loaded on the aircraft
  - Fuel dump operations
  - Regression testing of new vehicle systems software
- The test team accomplished radar signature testing on BF-5 after the aircraft was returned to the plant for four months for final finishes.
- The test team began weapon-separation flight tests in August when BF-5 accomplished a successful safe separation of an inert GBU-32 JDAM.
- As of the end of November, the sortie rate for the F-35B flight sciences test aircraft was 6.8 sorties per aircraft per month, compared to the goal of 4.4. The program accomplished 153 percent of the planned F-35B flight sciences sorties, completing 374 vice 244 planned.

Flight Sciences Assessment

- Although the program exceeded the objectives planned for sortie rate through the end of November, the progress against planned baseline test points for 2012 lagged by 45 percent with 1,075 test points accomplished against 1,939 planned. This was primarily a result of higher-than-expected loads on weapon bay doors, which prevented planned envelope expansion test points and required additional unplanned testing.
- To compensate for not being able to accomplish the planned envelope expansion test points, the test team pulled an additional 992 points from testing planned for 2013 back into 2012 and added 292 points for regression testing of new software. As of the end of November, the program had accomplished 2,359 total test points for the year. By pulling test points to 2012 that were originally planned for execution in later years, the test team was able to keep pace with the program's overall cumulative SDD test point objectives. Like the F-35A, loads on the weapons bay doors prevented test point accomplishment for internally-loaded weapons; test points with external stores were accomplished instead. For F-35B flight sciences, the test team had completed 106 percent of the planned quantity of cumulative SDD test points scheduled for completion by the end of November (7,480 cumulative points accomplished against a goal of 7,057 points).
- The test team continued investigations into the impact of transonic roll-off and transonic buffet in the F-35B; these investigations are not complete. The program introduced new F-35B vehicle systems software to reduce rudder and flaperon hinge moment in the transonic/supersonic region. The program expected to see improvements in transonic wing roll-off with these changes, but results were not available at the end of November 2012.
- The following table, first displayed in the FY11 Annual Report, describes the observed door and propulsion problems by component and identifies the production cut-in, if known. A significant amount of flight test and validation of an adequate final STOVL-mode configuration (doors and propulsion system) remains to be accomplished.

F-35 B Door and Propulsion Problems				
Category	**Component**	**Problem**	**Design Fix and Test Status**	**Production Cut-In**
Subsystems	Upper Lift Fan Inlet Door Actuators	High actuator failure rates.	Root cause analysis is complete and failure modes are limited to open position (i.e., failure to close); the doors have not failed to open when commanded, which allows lift fan operations. New actuator design is complete and testing is entering final stage of qualification.	BF-38 Low-Rate Initial Production (LRIP) 6 2014
Structure	Auxiliary Air Inlet Door (AAID)	Inadequate life on door locks, excessive wear and fatigue due to the buffet environment, inadequate seal design.	Redesigned door undergoing testing on BF-1. Loads testing completed and verified. Static testing on ground test article (BG-1) is complete, fatigue testing started in November.	BF-38 LRIP 6 2014
Structure	Lift Fan Door Actuator Support Beam	Cracks occurring earlier than predicted. Root cause analysis showed fastener location incorrectly inserted in design.	BF-1, BF-2, and BF-4 modifications are complete. BF-3 will not be modified (will not be used for STOVL Mode 4 operations). BF-4 has resumed Mode 4 operations. Design fix is on BF-5 and subsequent aircraft and new configuration is to full life.	BF-5 LRIP 2 2012
Structure	Roll Control Nozzle (RCN) Doors	Doors separated from aircraft BF-2 and BF-3 during flight; door loads not well understood, aero pressures higher than expected. Impact not limited to STOVL mode operations – flight not to exceed 400 KCAS below 18K ft and 0.5 minimum g-load.	BF-2 and BF-3 were modified with an interim design, instrumented, and flown to verify the updated loads used to develop the interim and final design doors. The Program Office is reviewing a redesign to support production in LRIP 6.	BF-38 LRIP 6 2014
Structure	3 Bearing Swivel Nozzle Door	Door attachment wear/damage found on BF-1 (6/11) requiring new inspection interval every 25 Mode-4 (vertical-lift-fan-engaged) flights. During Slow Landing flight testing, measured door loads exceeded limits.	Interim mod complete on BF-1 and BF-2, instrumentation added and flight test is ongoing. Production redesign is in progress.	BF-44 LRIP 7 2015
Structure	Main Landing Gear (MLG) Doors	Door cracking observed on BF-1, -2, and -4 aft door adjacent to aft lock.	Instrumentation added to BF-2 and flight loads testing complete. Models correlated and root cause confirmed. Modification of the rest of the SDD fleet is in work; production redesign is in progress. MLG door modification will be concurrent with AAID modification.	BF-44 LRIP 7 2015
Propulsion	Drive Shaft	Lift fan drive shaft undergoing a second redesign. Original design inadequate due to shaft stretch requirements to accommodate thermal growth, tolerances, and maneuver deflections.	Full envelope requirements are currently being met on production aircraft with an interim design solution using spacers to lengthen the early production drive shaft. Due to the heavy maintenance workload associated with the spacers, the Program Office is pursuing an improved design that does not require class spacers. The initial improved driveshaft design failed qualification testing. A new design is under development.	BF-44 LRIP 7 2015
Propulsion	Clutch	Lift fan clutch has experienced higher than expected drag heating during conventional (up and away) flight.	Testing completed to determine root cause of drag heating. Fix includes clutch plate width reduction on LRIP 5 and 6 aircraft, at the expense of reduced life (engagements) to the clutch. The Program Office is investigating alternate plate material to meet engagement requirement on subsequent LRIPs.	BF-44 LRIP 7 2015
Propulsion	Roll Post Nozzle Actuator	Roll post nozzle bay temperatures exceed current actuator capability. Actuator failure during Mode 4 operations.	Insulation between the roll post nozzle bay and the actuator has been installed and testing completed through the STOVL flight envelope. All LRIP aircraft have been fitted with insulation to reduce heat transfer into the bay and wear on current actuator. A newly designed, more heat tolerant actuator is scheduled to begin testing in early 2013.	TBD, depending on testing and production of redesigned actuator; retrofit of early production fleet will occur by attrition.
Propulsion	Bleed Air Leak Detectors	Nuisance overheat warnings to the pilot are generated because of poor temperature sensor design; overheats are designed to be triggered at 460 degrees F, but have been annunciated as low as 340 degrees F.	More accurate temperature sensors in the bleed air leak detectors have been designed and delivery for production aircraft started in January 2012.	Detectors on early LRIP aircraft will be replaced by attrition.
Propulsion	Auxiliary Air Inlet Door Aft down-lock seal doors (aka "saloon doors")	Doors are spring-loaded to the closed position and designed as overlapping doors with a 0.5 inch gap. The gap induces air flow disturbance and make the doors prone to damage and out-of-sequence closing. Damage observed on BF-5.	Seal doors are being redesigned with non-overlapping doors and stronger spring loads to ensure proper sequencing and full closure of the doors.	TBD

- The status of F-35B door and propulsion deficiencies follows.
  - The upper lift fan inlet doors continue to fail to operate correctly due to poor actuator design. Crews have observed failure of the doors to close on flight test aircraft and the early LRIP aircraft at Eglin AFB during ground operations. Ground maintenance workaround procedures are in place to ensure correct door operation; however, standard maintenance procedures for fleet operations are not yet in place. Newly designed actuators will not be available for production cut-in until BF-38, a Lot 6 delivery in 2014.
  - Redesign of the auxiliary air inlet doors is complete. The test team accomplished flight testing of the aerodynamic loads on the BF-1 doors early in 2012, and modified the F-35B static test article with the new auxiliary air inlet doors in August 2012 in preparation for static and durability testing. The static load testing was completed in mid-November, followed by the start of durability testing. Results of the testing were not available as of the time of this report.
  - Testing and analysis continued on the three-bearing swivel nozzle doors. The test team added instrumentation on BF-1 in January to assess the dynamic loads on the door to support an engineering redesign. BF-2 was modified and flight testing of the design is ongoing as of the time of this report. Redesign for both the production cut-in and the retrofit plans is in review at the Program Office. Fleet restrictions will remain in effect (slow landings below 100 KCAS are prohibited) until the program modifies the nozzle doors.
  - Temperatures in the roll control nozzle actuator area exceeded the heat tolerance of the current actuator design during flight test, necessitating a redesign. The program is changing the insulation in the nozzle actuator area as an interim fix and redesigning the nozzle actuator to improve heat tolerance. The program plans to begin testing the newly designed nozzle actuator in early 2013.
  - After roll control nozzle doors separated in-flight in 2011, additional testing of the aerodynamic loads on the doors led to a door redesign. A production redesign currently under review with the Program Office increases the closing forces on the door to prevent aerodynamic loads opening and possibly damaging doors or causing door separation.
  - The material solution to unacceptably high clutch temperatures observed during developmental testing is to reduce the width of the clutch plates in later LRIP aircraft with the expectation of reducing the drag and associated heating during all modes of flight. Clutch temperatures are monitored by aircraft sensors, which alert the pilot when normal temperature limits are exceeded. The associated pilot procedures to reduce high clutch temperatures require changing flight regimes to a cooling envelope of lower altitude (below 11,000 feet) and lower airspeed (less than 280 knots); such a procedure during combat missions would likely increase the vulnerability to threats and cause the pilot to abort the mission. Further, a vertical landing under high clutch temperature conditions needs to be avoided if possible, making return to forward basing or ship-borne operations in the combat zone, where a vertical landing would be required, not practical.
  - The program added spacers to the lift fan driveshaft to address unanticipated expansion/stretching that takes place during flight. This is an interim solution while the program redesigns the driveshaft for better performance and durability.
- Weight management of the F-35B aircraft is critical to meeting the Key Performance Parameters (KPPs) in the ORD, including the vertical lift bring-back requirement. This KPP requires the F-35B to be able to fly an operationally representative profile and recover to the ship with the necessary fuel and balance of unexpended weapons (two 1,000-pound bombs and two AIM-120 missiles) to safely conduct a vertical landing.
  - Weight reports for the F-35B have varied little in 2012, increasing 14 pounds from either changes in the manufacturing processes or more fidelity in the weight estimate. Current estimates are within 231 pounds (0.71 percent) of the not-to-exceed weight of 32,577 pounds – the target weight of the aircraft in January 2015 to meet specification requirements and ORD mission performance requirements for vertical lift bring-back. The small difference between the current weight estimate and the not-to-exceed weight allows for weight growth of 0.32 percent per year.
  - Managing weight growth with such small margins will continue to be a significant program challenge. Since the program will conduct the technical performance measurement of the aircraft in January 2015, well before the completion of SDD, continued weight growth through the balance of SDD will affect the ability of the F-35B to meet the STOVL mission performance KPP during IOT&E. Additionally, production aircraft are weighed as part of the government acceptance process, and the early LRIP lot F-35B aircraft were approximately 150 pounds heavier than the predicted values found in the weight status report.
- The program announced an intention to change performance specifications for the F-35B, reducing turn performance from 5.0 to 4.5 sustained g's and extending the time for acceleration from 0.8 Mach to 1.2 Mach by 16 seconds. These changes were due to the results of air vehicle performance and flying qualities evaluations.
- Other discoveries included:
  - As with the F-35A, horizontal tail surfaces are experiencing higher than expected temperatures during sustained high-speed/high-altitude flight, resulting in delamination and scorching of the surface coatings and structure. The program modified the tail surfaces of BF-2 in September to permit flight testing at higher airspeeds. The coatings delaminated during flight,

however, suspending further flight testing in the higher airspeed envelope until a new plan for the coatings can be developed.
- Fuel dump testing is ongoing on BF-4 after a redesign of seals on the lower trailing edge flaps. Previous testing with the original seals resulted in fuel penetrating the cove area behind the flaps and wetting the fuselage, allowing fuel to pool near the Integrated Power Package exhaust where the fuel is a fire hazard. Testing with the new seals has shown less fuel penetration with flaps fully retracted and with flaps extended to 20 degrees; however, fuel traces inside the flaperon cove were observed during post-flight inspections. The test team is also testing redesigned exit nozzles of different shape and cross-sectional areas. As of the end of November 2012, 11 relevant test flights have been accomplished; more flights will be necessary to resolve the deficiency.
- Planned wet runway testing, required to assess braking performance with a new brake control unit, has been delayed due to the inability to create the properly degraded friction conditions at the Patuxent River Naval Air Station (NAS), Maryland. The F-35B training aircraft at Eglin will be restricted to dry runway operations only until the wet runway testing is completed.

F-35C Flight Sciences

Flight Test Activity with CF-1, CF-2, and CF-3 Test Aircraft

- F-35C flight sciences focused on:
  - Verification of the basic flight envelope for the first production F-35C aircraft
  - Expansion of the flight envelope with external weapons loaded on the aircraft (AIM-9X short-range missile in subsonic flight)
  - Testing of arresting hook system modifications
  - Preparing for executing carrier landings in the simulated carrier environment at Lakehurst Naval Test Facility, New Jersey, including handling qualities at approach speeds at carrier landing weights
  - Surveying handling qualities in the transonic flight regimes
  - Regression testing of new air vehicle systems software
- As of November, the test team executed a sortie rate of 7.1 sorties per aircraft per month compared to the goal of 6.4. The program accomplished 110 percent of the planned F-35C flight sciences sorties, completing 233 vice 211 planned through the end of November.
- The program plans to deliver the final F-35C flight sciences aircraft, CF-5, in late 2012, followed soon by the first production F-35C from Lot 4. CF-5 flew its first company acceptance flight at the end of November.

Flight Sciences Assessment

- The program completed 80 percent of the baseline test points planned though November 2012, accomplishing 1,060 test points of a planned 1,327. Flight restrictions blocked accomplishment of a portion of the planned baseline test points until a new version of vehicle systems software became available.
- The test team flew an additional 253 test points from flight test requests and pulled 896 test points forward from work planned for 2013.
- By accomplishing envelope test points planned for completion in later years, the test team was able to keep ahead of the cumulative SDD test point objectives, as was the case in F-35A and F-35B flight sciences. While awaiting new vehicle systems software required to complete planned envelope testing in 2012, the test team accomplished points in other areas of the flight envelope. For F-35C flight sciences, the test team had accomplished 116 percent of the planned number of cumulative test points scheduled for completion by the end of November (4,330 cumulative points accomplished against a goal of 3,748 points).
- Weight management of the F-35C variant is important for meeting air vehicle performance requirements. F-35C weights have generally decreased in the monthly estimates during 2012. The latest weight status report from November 2012 showed the estimated weight of 34,522 pounds to be within 346 pounds (1.0 percent) of the projected maximum weight needed to meet technical performance requirements in January 2016. This margin allows for 0.31 percent weight growth per year. The program will need to continue rigorous weight management through the end of SDD to avoid performance degradation and operational impacts.
- The program announced an intention to change performance specifications for the F-35C, reducing turn performance from 5.1 to 5.0 sustained g's and increasing the time for acceleration from 0.8 Mach to 1.2 Mach by at least 43 seconds. These changes were due to the results of air vehicle performance and flying qualities evaluations.
- Discoveries included:
  - Due to the difference in wing design, transonic buffet becomes severe in different portions of the flight envelope and is more severe in the F-35C than the other variants. The program is making plans for investigating how to reduce the impact of transonic roll off in the F-35C with the use of wing spoilers; however, detailed test plans are not complete.
  - As with the F-35A and F-35B, horizontal tail surfaces are experiencing higher than expected temperatures during sustained high-speed/high-altitude flight, resulting in delamination and scorching of the surface coatings and structure. In August, the test team installed new coatings on CF-1 horizontal tails, designed to prevent scorching and delaminating during prolonged use of afterburner pursuing high airspeed test points. However, portions of the coatings dis-bonded during flight, suspending further testing of the high airspeed portion of the envelope.
  - The test team investigated alternative trailing edge flap settings to improve flying qualities during carrier landing approach. While pilot surveys showed handling qualities were improved with a 15-degree flap setting, flight test data to date have shown that 30 degrees of flaps are required to meet the KPP for maximum approach speed of 145 knots at required carrier landing weight.

Mission Systems

Flight Test Activity with AF-3, AF-6, AF-7, BF-17, and BF-18 Test Aircraft and Software Development Progress

- Mission systems are developed and fielded in incremental blocks of capability.
  - Block 1. The program designated Block 1 for initial training capability and allocated two increments: Block 1A for Lot 2 (12 aircraft) and Block 1B for Lot 3 aircraft (17 aircraft). No combat capability is available in either Block 1 increment. (Note: Remaining development and testing of Block 0.5 initial infrastructure was absorbed into Block 1 during the program restructuring in 2011.)
  - Block 2A. The program designated Block 2A for advanced training capability and associated this block with Lots 4 and 5. No combat capability is available in Block 2A.
  - Block 2B. The program designated Block 2B for initial, limited combat capability for selected internal weapons (AIM-120C, GBU-32/31, and GBU-12). This block is not associated with the delivery of any production aircraft. Block 2B software will be used to retrofit earlier production aircraft.
  - Block 3i. Block 3i is Block 2A capability re-hosted on an improved integrated core processor for Lots 6 through 8.
  - Block 3F. The program designated Block 3F as the full SDD capability for production Lot 9 and later.
- The Patuxent River test site accepted two early production aircraft from Lot 3 (BF-17 and BF-18) to support mission systems development and testing, in accordance with guidance following the Technical Baseline Review (TBR) in October 2010. Aircraft BF-17 ferried to Patuxent River on October 4th and BF-18, on November 8th. BF-17 began radar signature testing soon after arrival; BF-18 has yet to fly test sorties.
- The four mission systems flight test aircraft, three assigned to the Edwards AFB test center, and one BF-17 assigned to Patuxent River, flew an average rate of 5.0 sorties per aircraft per month through November, exceeding the planned rate of 4.4 by 14 percent. Mission systems test aircraft flew 115 percent of the test flights planned through the end of November (222 sorties completed compared to 193 planned).
- The test team accomplished 95 percent of the planned 2012 baseline test points by the end of November (1,238 baseline test points accomplished, 1,308 planned). The team also accomplished an additional 610 test points for regression testing of additional revisions of Block 2A software.

Mission Systems Assessment

- The program made limited progress in 2012 in fielding capability, despite relatively high sortie and test point completion rates.
  - Software delivery to flight test was behind schedule or not complete when delivered.
    - Block 1 software has not been completed; approximately 20 percent of the planned capability has yet to be integrated and delivered to flight test.
    - The first version of Block 2A software was delivered four months late to flight test. In eight subsequent versions released to flight test, only a limited portion of the full, planned Block 2A capability (less than 50 percent) became available and delivered to production. Block 2A has no combat capability.
    - Block 2B software was planned to be delivered to flight test by the end of 2012, but less than 10 percent of the content was available for integration and testing as of the end of August. A very limited Block 1B software version was delivered to the Cooperative Avionics Test Bed aircraft in early November for integration testing.
    - The program made virtually no progress in the development, integration, and laboratory testing of any software beyond 2B. Block 3i software, required for delivery of Lot 6 aircraft and hosted on an upgraded processor, has lagged in integration and laboratory testing.
  - The test team completed 1,238 (95 percent) of the planned 1,308 baseline test points by the end of November. The team also completed an additional 610 points for regression of multiple versions of software. Although the test team accomplished test points in 2012 as planned, little flight testing of advanced mission systems capability has taken place. Additionally, current planning of baseline test points results in shortfalls in production aircraft capabilities that will persist into 2014. Only 2,532 (23 percent) of the 10,966 total mission systems test points planned for SDD have been accomplished as of the end of November 2012. Of those completed, 54 percent supported testing of basic mission systems capabilities, such as communications, navigation, and basic radar functions, with the remaining 46 percent being comprised of radar signature testing (which does not involve or require any mission systems capability), software maturity demonstrations, and verification of capabilities for early production aircraft delivery.
- Although all Lot 2 and Lot 3 aircraft – in the Block 1 configuration – were either delivered to the Services or awaiting final delivery as of the time of this report, the test team had accomplished only 54 percent (738) of the 1,371 test points in the original Block 1 test plan. This resulted in the Lot 2 and Lot 3 aircraft being accepted by the Services with major variances against the expected capabilities and added to a bow wave of test points that will have to be completed in the future.
  - For example, when six F-35A and six F-35B Lot 2 aircraft were delivered to the training center in the Block 1A configuration, only 37 of 51 Block 1A capabilities on contract were delivered. Subsequently, the program delivered ten Lot 3 aircraft to the training center in 2012 in a partial Block 1B configuration (three F-35As, five F-35Bs, and two F-35Bs produced for the United Kingdom).

- The Block 1B configuration was designed to provide an additional 35 capabilities; however, the program delivered only 10 prior to the delivery of the first Lot 3 aircraft. The program is in the process of upgrading Block 1A aircraft to the 1B configuration; however, no additional capabilities were delivered with the Block 1B configuration. Examples of expected capabilities that were not delivered include air vehicle and off-board prognostic health management tools, instrument landing system (ILS) for navigation, distributed aperture system (DAS) video displaying in the helmet, corrosion data recording capability, and night vision imaging integration with the helmet.

- The Services began accepting Lot 4 aircraft in the Block 2A configuration in November with major variances against the expected capabilities. The program plans to continue to develop and test the incomplete and remaining Block 2A capabilities using incremental versions of Block 2A software and update the aircraft previously delivered with partial capabilities in late 2013. The continued development and testing of Block 2A software will be accomplished concurrently with the Block 2B software capabilities.
- Simultaneous development of new capabilities, associated with the next blocks of software, competes with the flight test resources needed to deliver the scheduled capability for the next lot of production aircraft.
  - For example, the testing needed for completion of the remaining 20 percent of Block 1 capabilities and 50 percent of Block 2A capabilities will have to be conducted while the program is introducing Block 2B software to flight test. Software integration tasks supporting Block 2B (and later increments) were delayed in 2012 as contractor software integration staff were needed to support Block 2A development, test, and anomaly resolution.
  - This process forces the program to manage limited resources, including the software integration labs, the cooperative avionics test bed aircraft, and the mission systems test aircraft, to address the needs of multiple versions of software simultaneously. The demand on flight test to complete test points for verification of capability for production software releases, while simultaneously accomplishing test points for expanding development of capability will continue to challenge the test team and add to the inherent concurrency of the program. The program intends Block 3i to enter flight test in mid-2013, which will be conducted concurrently with the final 15 months of Block 2B flight test. The program intends for Block 3F to enter a 33-month developmental flight test period in early 2014.
- Recognizing the burden and challenges caused by the concurrency of production and flight test, the Program Office is developing a capability management plan and review board to evaluate priorities and trades of capabilities within blocks and for deferral out of SDD if necessary.
- Shortfalls in the test resources required to test mission systems electronic warfare capabilities under operationally realistic conditions were identified by DOT&E in February. The needed resources and funding were being considered by the Department at the time of this report.
- Discoveries included:
  - The test team continued to work through technical problems with the helmet-mounted display system, which is deficient. The program was addressing five problems at the time of this report. Jitter, caused by aircraft vibrations and exacerbated by aircraft buffet, makes the displayed information projected to the pilot hard to read and unusable under certain flight conditions. Night vision acuity is not meeting specification requirements. Latency of the projected imagery from the DAS is currently down to 133 milliseconds, below the human factors derived maximum of 150 milliseconds, but still requires additional testing to verify adequacy. Boresight alignment between the helmet and the aircraft is not consistent between aircraft and requires calibration for each pilot. Finally, a recently discovered technical problem referred to as “green glow” has been experienced when light from the cockpit avionics displays leaks into the helmet-mounted display and degrades visual acuity through the helmet visor under low ambient light conditions. The test team is planning additional, dedicated ground and flight testing to address these technical problems.
  - Electronic warfare antenna performance of the first three production lots of aircraft was not meeting contract specification requirements. Poorly designed connectors created signal distortion in the six antenna apertures embedded in the aircraft. The Program Office determined that 31 aircraft are affected and require additional testing of each antenna. Testing of the apertures began on SDD aircraft at Edwards AFB in November. Progress in verifying the performance of the electronic warfare system will be affected until additional testing of the apertures in the aircraft is completed and any necessary retrofits accomplished on the mission systems test aircraft.
  - Helmet-mounted display video imagery needed to successfully analyze and complete portions of the mission systems test plans cannot be reliably recorded on either the portable memory device or the data acquisition recording and telemetry pod. The program began testing fixes in August. Until resolved, the overall impact is 336 total mission systems test points that are not achievable.
  - The program projects utilization rates for the two processors that support the panoramic cockpit display to be greater than 100 percent when assessed against Block 3 capabilities. The program initiated plans to optimize the core processor software to reduce these rates.
  - The program is tracking mission system software stability by analyzing the number of anomalies

observed as a function of flight time. Current program objectives for early mission system software in flight test are to have integrated core processor and Communications/Navigation/Identification Friend or Foe (CNI) anomaly rates be 15 hours or more between events. Recent reports for the latest mission systems software in flight test – version 2AS2.8 – show a rate of 6.3 hours between anomalies based on 88 hours of flight test.

Weapons Integration

- Weapons integration includes flight sciences, mission systems, and ground maintenance support. Testing includes measuring the environment around the weapon during carriage (internal and external), handling characteristics of the aircraft, safe separation of the weapon from the aircraft, and weapons delivery accuracy events.
- In 2012, the program conducted detailed planning of the weapons integration events necessary to complete SDD. This planning yielded a schedule for completing weapons integration for Block 2B and Block 3F combat capability.
- The test team conducted the flight sciences loads, flutter, and environmental testing necessary to certify a limited Block 2B carriage envelope of the F-35A and F-35B aircraft for Joint Direct Attack Munition, GBU-12 laser guided bomb, and the AIM-120 air-to-air missile to enable the start of active flight testing. As of the end of October, this testing had achieved captive carriage and first safe separation of an inert AIM-120 missile (on the A model) and inert Joint Direct Attack Munition (on both the A and B model). However, to date, weapons integration has been limited by the following deficiencies:
  - Instrumentation
  - Data recording shortfalls
  - Deficient mission systems performance in radar, Electro-Optical Targeting System (EOTS), fusion, and the helmet
  - Lack of radar fusion support to the AIM-120 air-to-air missile
  - EOTS inability to accurately track and designate targets for the air-to-ground munitions,
  - Deficient fused situational awareness presentation to the pilot
- The successful execution of the detailed schedule developed this year was dependent on:
  - The ability of the program to deliver mission systems capability required to start weapons integration in April 2012
  - Adequate margin in the test schedule to accommodate repeated testing, cancellations due to weather, range assets, and operational support
  - Reliable instrumentation and range support
- None of these assumptions have proven true, adding risk to the execution of the overall schedule. Deferrals of mission systems capabilities to later blocks and delays for corrections to test instrumentation and data recording have removed the schedule margins. The impact of these delays will potentially require an additional 18 months added to the schedule for weapons integration events.

Static Structural and Durability Testing

- Durability testing on the ground test articles of all three variants continued in 2012; progress is measured in aircraft lifetimes. An aircraft lifetime is defined as 8,000 Equivalent Flight Hours (EFH), which is a composite of time under different test conditions (i.e., maneuver and buffet for durability testing). In accordance with the SDD contract, all three variants will complete two full lifetimes, or 16,000 EFH of durability testing. The completion dates for the second aircraft lifetimes are late 2014 for the F-35B and early 2015 for the F-35A and F-35C. Plans for a third lifetime of durability testing for all three variants are under development.
- The F-35A ground test article, AJ-1, completed the first of two planned aircraft lifetimes in August, as planned. F-35A durability testing continued into the second planned aircraft lifetime at the time of this report, completing 9,117 EFH as of December 5, 2012.
- F-35B durability testing on BH-1 was restarted in January after a 16-month break caused by the discovery, analysis, and repair of a crack in a wing carry-through bulkhead at 1,055 EFH. Since restarting, an additional 5,945 hours of testing had been completed by the end of October, bringing the total test time to 7,000 EFH and putting the testing ahead of the restructured 2012 plan to complete 6,500 hours by the end of the year.
- F-35C durability testing began in March and the test article, CJ-1, had completed 4,000 EFH of fatigue testing as of October, as scheduled.
- Component durability testing for two lifetimes of the vertical tails was completed for the F-35A and F-35B during 2012. This testing was started in August for the F-35C. Component testing of the horizontal tail for the F-35C completed 8,000 EFH, or one lifetime, in May, and an additional 2,000 EFH by the end of October. (Component testing of the horizontal tails for the F-35A and F-35B completed two lifetimes of testing in 2011.)
- The program redesigned the F-35B auxiliary air inlet doors, required for STOVL operations, and began flight testing in 2012. Redesigned doors have been installed on the static loads test article (BG-1) and completed static loads testing in early November, followed by the start of durability testing. The report from the static testing is scheduled to be completed by the end of 2012; however, the results of the durability testing are not scheduled to be available until mid-2013. The program has already ordered, received, and begun installing retrofit kits for the auxiliary air inlet door modifications on fielded Lot 4 aircraft.
- Discoveries from durability testing included significant findings in both the F-35A and F-35B ground test articles.
  - In the F-35A, a crack was discovered on the right wing forward root rib at the lower flange (this is in addition to the crack found and reported in the FY11 Annual Report).

Also, a crack was found by inspection in the right hand engine thrust mount shear web in February. Testing was halted while the crack was inspected and analyzed, then restarted to complete subsequent blocks of testing.
- In the F-35B, the program halted testing in December 2012 after multiple cracks were found in a bulkhead flange on the underside of the fuselage during the 7,000-hour inspection. Root cause analysis, correlation to previous model predictions, and corrective action planning were ongoing at the time of this report. Other cracks were previously discovered in the B-model test article; one on the right side of the fuselage support frame in February and one at a wing pylon station in August, both of which were predicted by modeling. Another crack in the shear web tab that attaches to the support frame was discovered in March. Also, excessive wear was found on the nose landing gear retractor actuator lugs and weapons bay door hinges. All of these discoveries will require mitigation plans and may include redesigning parts and additional weight.

- The results of findings from structural testing highlight the risks and costs of concurrent production with development. The Program Office estimates of the weight changes to accommodate known limited life parts discovered so far from structural testing are shown in the table below. These weight increases are in the current weight status reports for each of the variants. Discoveries during the remaining two years of structural testing will potentially result in more life-limited parts and associated impacts to weight and design.

Variant	Number of Life Limited Parts	Retrofit Weight Increase to Early LRIP Aircraft (prior to production cut-in)	Production Weight Increase (cut-in varies from LRIP 4 to LRIP 7)
F-35A	19	38 pounds	20 pounds
F-35B	20	123 pounds	33 pounds
F-35C	7	5 pounds	1 pound

Modeling and Simulation

Verification Simulation (VSim)

- The Verification Simulation (VSim) is a man-in-the-loop, mission software-in-the-loop simulation developed to meet the operational test agencies' requirements for Block 2B OT&E and Block 3 IOT&E.
- The program continued detailed technical reviews of the VSim with the contractor and subcontractors supplying its component models during 2012. Sensor model reviews took place for the electronic warfare, radar, and DAS infrared sensors. The program held similar detailed reviews for the inertial navigation system (INS) and Global Positioning System (GPS) models, as well as for the VSim Battle Space Environment (BSE), a collection of background environment models with which the sensor and navigation system models interact.
- At the time of this report, the program was tracking 11 formal risks with regard to VSim, 4 of them characterized as high risk, the other 7 characterized as moderate. These 11 risks fall into 4 general categories:
  - Risks associated with timeliness of VSim software delivery, completeness with regard to modeled capabilities, and discrepancies between VSim and aircraft software due to mismatches in the software versions that are current in VSim and those that are current in the aircraft at any given time.
  - Risks associated with the timeliness, completeness, and production-representativeness of data from flight testing and other testing used to verify and validate VSim.
  - Risks regarding the time and manpower needed to analyze VSim validation data and perform accreditation assessments.
  - Fundamental risks regarding the ability of VSim to faithfully replicate all aspects of F-35 and threat systems performance.
- In addition to the risks cited by the Program Office, DOT&E has highlighted shortfalls in the test resources needed to gather key elements of data required for validation of the VSim for IOT&E, in particular for electronic warfare performance. These shortfalls are a function of limitations in the test assets currently available to represent threat systems. DOT&E has made formal recommendations to address the shortfalls.

Other Models and Corporate Labs Activity

- The Program Office has accredited 7 of the 28 models and simulations currently planned to support verification of the F-35.
- The program accredited three models intended for use in contract specification verification in 2012. These are the Ejection Seat Model, the Support Enterprise Model (SEM), and the Automatic Dynamic Analysis of Mechanical Systems (ADAMS) model. A fourth model, Prognostic Health Management (PHM) Coverage Analysis Tool (PCAT), is in final accreditation review at the Program Office at the time of this report.
  - The Ejection Seat Model is used to verify the terrain clearance requirements of the F-35 ejection seat under different flight conditions.
  - SEM is used to assess the logistics infrastructure requirements of the fielded F-35 Air System.
  - ADAMS is used to assess weapon store-to-aircraft clearances and interfaces during loading, carriage and separation, evaluating weapon arming and de-arming, and other weapons system separation functions.
  - PCAT is a spreadsheet-based application that rolls-up probabilities of fault isolation and fault detection to various line replaceable units.
- The program plans to accredit 6 models and simulations intended for use in requirements verification plan in 2013, with the remaining 15 accreditations due between 2014 and the end of SDD in 2017.
- The Program Office has identified challenges for 2013 with respect to obtaining and analyzing, in a timely fashion, the

validation data needed to accredit the GPS System Model Simulation (GSMS) and Modeling System for Advanced Investigation of Countermeasures (MOSAIC) infrared countermeasures effectiveness models.

- In 2011, the Air Force airworthiness authorities identified the pilot escape system installed in the early LRIP aircraft as a serious risk. Validation of expected performance of the F-35 escape system is supported by modeling the ejection seat as well as the effectiveness of the transparency removal system for the canopy during the ejection sequence.
  - For the ejection seat model, the program used data from sled testing under straight and level conditions to predict performance of the ejection seat under non-zero angle-of-bank (including inverted) conditions. Interactions between the pilot, the ejection seat, and the canopy during the ejection sequence, however, are not well understood, particularly during other than straight and level ejection conditions.
  - Testing of the transparency removal system under off-nominal conditions to better understand these interactions was scheduled for March 2012. The program expects this testing to take place in December 2012.

Training System

- The program initiated flight operations at the Integrated Training Center, Eglin AFB, Florida, in 2012 with both the F-35A and F-35B aircraft.
  - The Air Force accepted six F-35A aircraft from production Lot 2 in 2011 at Eglin in the Block 1A configuration, but did not commence flight operations until March 2012 when the Air Force airworthiness authorities provided the necessary flight clearance, which limited operations to previously qualified F-35 pilots. In July, the Air Force changed the flight clearance to allow pilots not previously qualified to fly at Eglin, which paved the way for F-35A pilot training to begin later in the year.
  - The program delivered six F-35B aircraft from production Lot 2 to Eglin between January and May 2012. Also in May, Navy airworthiness authorities provided a flight clearance for F-35B flight operations to begin at Eglin.
  - The program added 10 production Lot 3 aircraft – all in the Block 1B configuration – to Eglin by the end of October 2012 to support flight training: 3 F-35A aircraft between July and August and 7 F-35B aircraft (5 for the Marine Corps and 2 for the United Kingdom) between July and October. These deliveries were later than planned due to late availability of an adequate Autonomous Logistics Information System (ALIS) at Eglin to support the Block 1B aircraft configuration.
- In July 2012, DOT&E recommended to the Air Force, the operational test agencies, and the JSF Program Office that the training OUE be delayed until the system matures and possesses some combat capability relevant to an operational evaluation.
  - DOT&E identified seven indicators which highlighted a lack of overall system maturity: abort rates higher, and trending flat, than the Air Force risk assessment identified for a maturing system; the trend in discovery as indicated by the rate of new Deficiency Reports; the high number of "workarounds" needed to support maintenance and sortie generation activities (including engineering support from the contractor); lack of a water-activated parachute release system (qualification testing is delayed until 2013); incomplete testing of the escape/ejection system; low overall availability rates; and no new information or plans to address deficiencies in the Integrated Caution and Warning System.
  - The Air Force elected to begin the training OUE in early September 2012, and concluded it in mid-November 2012. The system under test had no combat capability. Flight training events were limited to basic aircraft maneuvers called for in the "familiarization" pilot transition syllabus, which is a six-flight module of training. Pilots were trained in basic ground procedures, take-off, approach/landing, and formation flight. Radar, electronic warfare, countermeasures, and weapons capabilities were not included in the syllabus as they were either restricted from being used or were not available. Flight maneuvering was restricted to 5.5 g's, 550 knots, 18 degrees angle-of-attack, and below 39,000 feet altitude, and was further constrained by numerous aircraft operating limitations that are not suitable for combat. The maintenance environment and support systems are still immature. Sortie generation was dependent on contractor support personnel, maintenance personnel had to use workarounds to accommodate shortfalls in ALIS, and the Joint Technical Data was incomplete. DOT&E will provide an independent report on the evaluation in early 2013.
- As of the end of OUE in November, 276 sorties and 366 hours had been flown in the F-35A aircraft at Eglin, with the first flights in March, and 316 flights and 410 hours flown in the F-35B, since starting in May.
  - Aircraft availability rates for the F-35A varied from less than 5 percent to close to 60 percent in a given week from the first flights in March through October, with an average availability of less than 35 percent, meaning three of nine aircraft were available on average at any given time. For the F-35B, availability rates varied monthly as well from less than 5 percent to close to 50 percent, with similar average rates over the six months of flying.
  - Cumulative air abort rates over the same time period were also similar between the two variants with approximately five aborts per 100 flight hours observed (4.7 for the F-35A and 5.3 for the F-35B). In 2010, the Air Force used air abort rate as an objective metric for assessing the maturity needed to start flight training, with a goal of 1.0 air abort per 100 flight hours as a threshold to start an evaluation of the system's readiness for training. Ground abort rate was one ground abort in seven scheduled sorties (0.14) for the F-35A and one in eight (0.13) for the F-35B.
- The center conducted maintenance training for experienced maintenance personnel for both the F-35A and F-35B

during 2012. As of the end of November, 542 personnel had completed training in one or more of the maintenance courses. Graduates from the maintenance courses at the training center will support initial service bed down and training locations.

Air System-Ship Integration and Ship Suitability Testing

F-35B

- The Program Office continued planning efforts to support the next F-35B developmental testing deployment to USS *Wasp* in August 2013. Through the middle of November, the test team had accomplished 79 vertical landings in 2012 (358 total to date) and 212 short takeoffs (631 to date). Control law changes were made to the vehicle system software as a result of flying qualities observed during the first deployment to USS *Wasp* in 2011. Regression testing of the control law changes was accomplished in 2012.
- Discoveries affecting F-35B operations on L-class ships include:
  - Assessment of ship capabilities were inconclusive in determining whether there would be adequate storage requirements for lithium battery chargers and spares, gun pods, and the ejection seat carts as some of the support equipment and spares from legacy systems may no longer be required. Additional data are required to determine a path forward.
  - Propulsion system module containers do not meet all shipboard requirements. Due to the fragility of certain propulsion system components, there is significant risk to engines during transport to and from ships, using the current containers. The Program Office is coordinating a propulsion system fragility analysis which is expected to lead to a container redesign.
  - Concept of operations for managing and using the classified materials area remains to be resolved.

F-35C

- A redesign of the arresting hook system for the F-35C to correct the inability to consistently catch cables and compensate for greater than predicted loads took place in 2012. The redesign includes modified hook point shape to catch the wire, one-inch longer shank to improve point of entry, addition of damper for end-of-stroke loads, increased size of upswing damper and impact plate, addition of end-of-stroke snubber. In 2012, the following occurred:
  - Initial loads and sizing study completed showed higher than predicted loads, impacting the upper portion of the arresting hook system (referred to as the "Y frame," where loads are translated from the hook point to the aircraft) and hold down damper (January 2012)
  - Risk reduction activities, including cable rollover dynamics testing at Patuxent River (March 2012), deck obstruction loads tests at Lakehurst (April 2012)
  - Flight tests with CF-3 using new hook point and new hold down damper design at Lakehurst (August 2012)
  - 72 of 72 successful roll-in tests with MK-7 and E-28 gear
  - 5 of 8 successful fly-in tests; 3 of 8 bolters (missed wire)
  - Preliminary design review of updated design completed (August 15, 2012)
- Analysis by Service and program ship integration teams identified several aircraft-ship interface problems for resolution.
  - Deficient capability to transfer recorded mission data to ship intelligence functions for analysis, in particular video data recorded by the JSF.
  - Ships are unable to receive and display imagery transmitted via Link 16 datalink by JSF (or other aircraft).
  - The design of the JSF Prognostic Health Maintenance downlink is incomplete, creating concerns for sufficient interfaces with ship systems and Information Assurance.

Live Fire Test and Evaluation

System-Level Test Series

- The program completed two of the eight system-level test series. The first, LF-19D Flight-Critical System-Level test series, was conducted on the first F-35A flight test aircraft to assess the ballistic tolerance of the flight control system and its supporting systems (e.g., power thermal management, vehicle management, and electrical power systems).
- This test series targeted components of the redundant vehicle management and electrical power systems, demonstrating their ability to automatically reconfigure after damage, and to continue to operate with no obvious effect on the ability of the aircraft to remain in controlled flight.
- The Live Fire Test team is assessing the aircraft vulnerability damage thresholds and whether testing properly explored the intended ballistic damage modes (e.g., interference or arcing between 270 Volt, 28 Volt, and signal lines; loss of flight actuator stiffness; and/or impact to singularly vulnerable components such as the flight actuator ram cylinder).
- One test in this series, LF-19D-27, demonstrated aircraft vulnerabilities to fires associated with leaks from the PAO system. The aircraft uses flammable PAO in the avionics coolant system, which has a large footprint on the F-35. The threat in this ballistic test ruptured the PAO pressure line in the area just below the cockpit, causing a sustained PAO-based fire with a leak rate of 2.2 gallons per minute (gpm).
  - The program assessed that a similar event in flight would likely cause an immediate incapacitation and loss of the pilot and aircraft. The test article, like the production design, lacks a PAO shutoff system to mitigate this vulnerability.
  - In 2008, the JSF Executive Steering Board (JESB) directed the removal of PAO shutoff valves from the F-35 design to reduce the aircraft weight by 2 pounds. Given the damage observed in this test, the JESB directed the program to re-evaluate installing a PAO shutoff system through its engineering process based on a cost/benefit analysis and the design performance capabilities. The ballistic test results defined the significance of this vulnerability. However, the test also showed that a shutoff system needs

to outperform other fielded systems. To be effective, it must trigger on smaller leak rates, down to 2 gpm versus the 6 gpm typical of other aircraft designs, without causing excessive false alarms.
  - The program is currently working to identify a low leak rate technical solution. The Program Office will consider operational feasibility and effectiveness of the design, along with cost, to decide if PAO shutoff valves will be reinstated as part of the production aircraft configuration.
- Another test in this series, LF-19D-16, identified the vulnerability associated with fuel fires from fueldraulic system leaks. The fueldraulic system is a fuel-based hydraulic system used to control the engine exhaust nozzle. It introduces a significant amount of fuel plumbing to the aft end of the engine and, consequently, an increased potential for fire.
  - This test confirmed the increase in vulnerability. The original aircraft design included flow fuses, also known as excess flow check valves, to cutoff fuel flow when a leak is sensed due to downstream fuel line damage or failure. As a result of the weight-reduction initiative, the JESB directed removal of fueldraulic fuses from the production design in 2008 to provide weight saving of 9 pounds. Fuses, however, were still part of the non-weight-optimized F-35A test article used in this test.
  - While a ballistic test with fragment threats demonstrated that the fueldraulic system poses a fire-related vulnerability to the F-35, the leak rates generating the fire were insufficient to trigger the fuses. Since the fuses did not shut off the flow, the result was a sustained fuel-based fire.
  - The Program Office is accepting the increased vulnerability associated with the fueldraulic system and is currently not considering reinstating the fueldraulic fuses in the production aircraft configuration.
- A Computation of Vulnerable Area Tool analysis shows that the removal of the PAO coolant and fueldraulic systems results in a 25 percent increase in aircraft vulnerability.

Ballistic Analysis

- The program used a computational analysis, supported by single fragment test data, to evaluate the vulnerabilities of the F-35 to multiple missile warhead fragment hits for several encounter geometries.
  - Multiple missile warhead fragment hits are more combat-representative and will result in combined damage effects that need to be assessed. For example, aircraft may not be lost due to a fuel leak from a single missile fragment impact, but combined leakage from multiple impacts could prevent the aircraft from returning to base.
  - There are potentially other such combined effects that are not known or expected and that, due to the analysis limitations, cannot be identified. These limitations will introduce a level of uncertainty in the F-35 vulnerability assessment.
- The program used the results of the completed tests to assess the effects of ballistic damage on the capability of the aircraft to maintain controlled flight.
  - These estimates are typically expressed as a function of time intervals, i.e., 0 minutes ("catastrophic kill"), 30 seconds ("K-kill"), 5 minutes ("A-kill"), 30 minutes ("B-kill"), etc.; however, the program categorized them in terms that supported their specification compliance, i.e., "Loss of Aircraft" or the ability to "Return to Forward Line of Troops (FLOT)."
  - These limited categories do not provide detailed insight into the vulnerability of the aircraft. For example, with a Return to FLOT criterion of 55 minutes, if the aircraft could fly for 45 minutes it would still be classified as a Loss of Aircraft and no understanding is provided concerning the aircraft's actual capability to maintain controlled flight for those 45 minutes. Such an assessment does not provide insight into the actual operational survivability of the aircraft because it only focuses on the ability of the aircraft to fly for 55 minutes even though, in some instances, the pilot might need much less time to return to friendly territory.

STOVL Propulsion System Test Series

- The program completed most of the STOVL propulsion system test series. The Program Office temporarily suspended this test series due to budget constraints without notifying DOT&E. The remaining lift fan-to-clutch drive shaft and lift fan clutch static and dynamic tests have been postponed until FY13.
  - The LFT&E STOVL propulsion system tests confirmed that back-ups to hydraulic systems that configure the STOVL propulsion system for its various operating modes worked as intended.
  - The completed test events targeted the lift fan rotating and stator components while the fan was static. The program assumed that the lift fan would most likely be hit while in forward flight and that hits during STOVL flight were less likely. In most test events, the system was then run up to simulate a STOVL landing sequence.
  - The results indicated that test damage introduced no measurable degradation in STOVL propulsion performance, including cascading damage effects, and would be undetectable by the system and the pilot. However, due to concerns for catastrophic lift fan or drive train damage that would risk loss of the test article for subsequent tests, this test series did not include dynamic tests to the inboard portion of the lift fan blade, where the cross section is smaller and centrifugal forces are higher, making failure more likely.
  - The engine manufacturer is providing damage tolerance estimates for these threat-target conditions, which still need to be evaluated.

Vulnerability Assessment

- The program completed an intermediate vulnerability assessment (the previous one was in 2008) incorporating results from ballistic tests conducted to date, a higher-fidelity target model, and modified blast and fire curves.
  - The ORD requires an analysis of two types of fragments, a 30 mm high explosive incendiary (HEI) round and a Man-Portable Air Defense System (MANPADS) missile. The analysis showed that none of the F-35 variants met the operational requirements for the HEI threat. The analysis also showed that the F-35A and F-35C have shortfalls to the two fragment threats. The F-35B variant is more resistant to these two threats, primarily due to less fuel carried and some additional shielding provided by the lift fan.
  - Reinstatement of the dry bay fire extinguishing system, in combination with the PAO shutoff valve, and the fueldraulic fuses could make all F-35 variants compliant for all four specified ballistic threats, as currently defined in the ORD.

OBIGGS Redesign

- The program is redesigning OBIGGS to address deficiencies identified in earlier fuel system simulator test series (LF-09B) to meet the vulnerability requirements during all critical segments of a combat mission and to provide an inert tank atmosphere for internal lightning protection.
- The program reported several design changes during the Phase II Critical Design Review to:
  - Fix the vent-in-during-dive problem, wherein fresh oxygen-laden air is drawn into the fuel tanks in a dive
  - More uniformly distribute the nitrogen enriched air (NEA) throughout the fuel tanks
  - Ensure NEA quality
  - Inform the pilot when the system is not inerting the ullage
- The program will conduct verification and certification testing and analyses to confirm the performance of the new OBIGGS design on all three aircraft variants. These tests are expected to begin in FY13.
- Additionally, the current fuel tank venting design is inadequate to vent the tanks during a rapid descent. As a result of the related OBIGGS and tank venting deficiencies, flight operations are currently not permitted within 25 miles of known lightning conditions. Moreover, below 20,000 feet altitude, descent rate is restricted to 6,000 feet/minute. Dive rates can be increased to up to 50,000 feet/minute but only if the maneuver includes 4 minutes of level flight for fuel tank pressurization purposes. Neither restriction is acceptable for combat or combat training.

Chemical/Biological Survivability

- The F-35 Chemical Biological Warfare Survivability Integrated Product Team built and demonstrated a prototype full-scale shelter-liner for chemical/biological containment. The demonstration did not evaluate effectiveness, and the program determined the design was too complex for field use.
- The team is working on a lighter, more robust and less complex redesign. The integration of the new shelter-liner with the chemical and biological agent decontamination support system is ongoing with a full-up demonstration test planned for FY14.

Issues Affecting Operational Suitability

- Overall suitability performance demonstrates the lack of maturity in the F-35 as a system in developmental testing and as a fielded system at the training center.
- Reliability requirements are identified for system maturity (50,000 fleet hours), but the program predicts a target at each stage of development that projects growth toward the maturity requirement.
  - Analysis of data through May 2012 shows that flight test and Lots 1 through 3 aircraft demonstrated lower reliability than those predictions. Demonstrated Mean Flight Hours Between Critical Failure for the F-35A was 5.95 hours, for the F-35B was 4.16 hours, and for the F-35C was 6.71 hours, which are 60, 70, and 84 percent of the level predicted by the program for this point in development of each variant, respectively.
  - Although reliability results appear to indicate improvement over those reported in last year's report (2.65 for F-35A, 2.05 for F-35B, and 2.06 for F-35C, reflecting data through September 2011), too few flight hours have accrued (approximately 1.5 percent of the flight hours required to achieve reliability maturity) for these results to be predictive, and although they are based on a rolling three-month measure of reliability, have shown great variation between measurement periods.
- In 2012, the program updated the reliability growth plan for the first time since 2006. Significant contributors to low reliability by variant are:
  - F-35A – power and thermal management system, CNI, lights, fuel system, landing gear, fire control and stores, integrated air vehicle architecture, and electrical power system
  - F-35B – electrical power system, power and thermal management system, integrated air vehicle architecture (which includes the Integrated Core Processing system and the cockpit displays including the HMDS), access doors and covers, landing gear, oxygen system, stabilizers, lift fan system, crew escape and safety, and flight control system
  - F-35C – engine controls, power and thermal management system, electrical power system, landing gear, and integrated air vehicle architecture
- The amount of time spent on maintenance, or measures of maintainability, of flight test and Lots 2 and 3 aircraft exceeds that required for mature aircraft.

- Mean corrective maintenance time for critical failures by variant are:
  - F-35A – 9.3 hours (233 percent of the requirement of 4.0 hours)
  - F-35B – 8.0 hours (178 percent of the requirement of 4.5 hours)
  - F-35C – 6.6 hours (165 percent of the requirement of 4.0 hours)
- Mean times to repair by variant are:
  - F-35A – 4.2 hours (168 percent of the requirement of 2.5 hours)
  - F-35B – 5.3 hours (177 percent of the requirement of 3.0 hours)
  - F-35C – 4.0 hours (160 percent of the requirement of 2.5 hours)
- Maintainability of the system hinges on improvements and maturation of Joint Technical Data (JTD), and the ALIS functions that facilitate flight line maintenance.

- The program is developing and fielding the ALIS in incremental capabilities, similar to the mission systems capability in the air vehicle. It is immature and behind schedule, which has had an adverse impact on maintainability, and delays delivery of aircraft.
  - ALIS 102 is a limited capability and is the version fielded only at the Eglin training center. It was required for receiving and operating the early Lot 2 and Lot 3 aircraft, as well as for conducting initial aircrew and maintenance training. This version of ALIS operates with independent subsystems and requires multiple workarounds to support sortie generation and maintenance activities.
  - ALIS 103 is intended to provide the initial integration of ALIS subsystems. The program intended to make it available for the fielding of Lot 3 and Lot 4 production aircraft at new operating locations in 2012: Edwards AFB, California, and Yuma Marine Corps Air Station (MCAS), Arizona. The program discovered problems with ALIS security in February 2012, which in turn delayed the delivery of Lot 3 and Lot 4 aircraft from July to late in 2012. A formal evaluation of ALIS 103 was delayed until September 2012, and was completed in October. The first F-35B was delivered to Yuma MCAS on November 16, 2012, and the first F-35A to Edwards AFB is delayed to December 2012. These aircraft were ready for delivery as early as July 2012. A version of ALIS 103 has been fielded at Yuma MCAS for use with ground operations of the three Lot 4 F-35Bs delivered in November. Flight operations at Yuma are expected to start in early 2013. Similarly, ALIS 103 has been fielded at Edwards AFB and is expected to provide support delivery of aircraft and flight operations in early 2013.
  - Future versions of ALIS will complete the integration of subsystems. In 2012, the program made limited progress toward the development of a deployable unit-level version of ALIS by demonstrating only half of the unclassified functionality on representative hardware. The deployable version will weigh approximately 700 pounds less than the existing 2,466-pound system, and will be modular to enable transportation. Funding for development is being secured by the Program Office.
- The program continued the process of verifying JTD, the set of procedures used to operate and maintain the aircraft.
  - As of the end of September 2012, the program had verified 38 percent of the technical data modules (6,879 out of an estimated 17, 922), which is close to the planned schedule. The program plans to have approximately 11,600 (65 percent) of all the modules verified by the end of FY13.
  - Although the program has improved plans and dedicated effort for verifying and fielding JTD, the lack of JTD causes delays in maintenance actions that consequently affect the availability of aircraft.
- Data Quality and Integration Management (DQIM) are essential parts of the overall Autonomic Logistics Global Sustainment process for the F-35. Experiences with early production aircraft indicate an immature database that contains missing or incorrect part numbers, serial numbers, and missing scheduling rules for inspections. Effective data quality and integration management require that part numbers, serial numbers, and inspection requirements for each aircraft be loaded into ALIS for mission debrief or maintenance actions to occur.

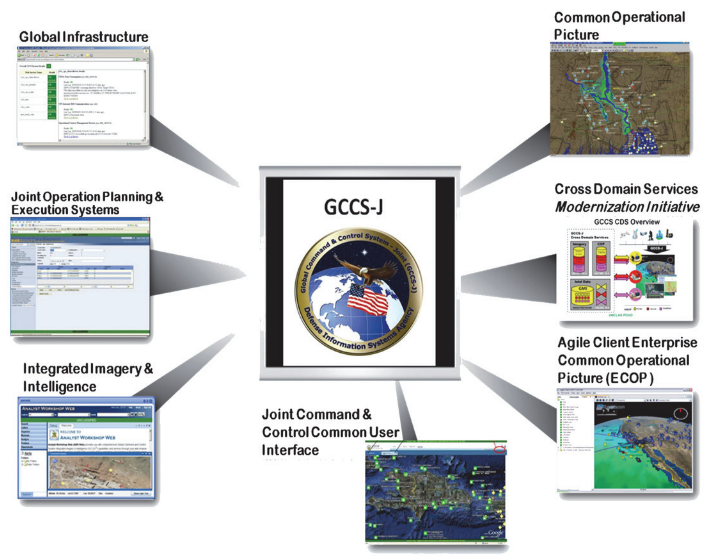
Progress in Plans for Modification of LRIP Aircraft

- The program and Services continued planning for modifications of early LRIP aircraft to attain planned service life and the final SDD Block 3 capability.
  - In January, the aircraft assembly plant received the first production wing parts, which the program redesigned as a result of life limits imposed by structural analyses. The assembly plant received the first F-35A forward root rib in January for in-line production of AF-31, the first Lot 5 F-35A aircraft, which is scheduled to deliver in 2013.
  - The operational test agencies worked with the Services and the Program Office to identify modifications required. Due to the extension of the program, which resulted in very early procurement (relative to the end of SDD) of the aircraft planned for IOT&E, there is high risk that the Service plans for updating the aircraft intended for IOT&E will not be production-representative. Activities to study the depth of the problem occurred in 2012; however, a comprehensive, funded plan that assures a production-representative set of aircraft for OT&E is not yet available. This is a significant and fundamental risk to an adequate IOT&E.
  - The first set of depot-level modifications for the F-35A aircraft are scheduled to begin at Hill AFB in early 2014. Initial F-35B modifications will be completed at the initial operating base at Yuma MCAS, Arizona. Modification of the Auxiliary Air Inlet Door, which is required for vertical landings, has begun on the first F-35B delivered to Yuma in November.

Recommendations

- Status of Previous Recommendations. The program and Services are satisfactorily addressing four of seven previous recommendations. The remaining three recommendations concerning use of objective criteria for evaluating flight test progress, integrating flight test of an operational mission data load, restoring shut-off valves, and redesigning the OBIGGS are outstanding.
- FY12 Recommendations. The program should:
  1. Make the corrections to Revision 4 of the JSF TEMP, as described by DOT&E September 2012 memorandum disapproving the TEMP
     - Include the electronic warfare test annex that specifically required operationally-realistic threats
     - Include adequate criteria for entering the final preparation period prior to IOT&E
     - Schedule the start of the final preparation period prior to IOT&E to begin no earlier than the Operational Test Readiness Review, approximately 90 days prior to the end of the air-worthiness certification phase of development
  2. Conduct dedicated ALIS end-to-end developmental testing of each incremental ALIS version that supports the production aircraft.
  3. Assure modification and retrofit plans for OT aircraft make these aircraft fully production-representative.
  4. Ensure the contractor is meeting VSim requirements for operational testing and is addressing data requirements to support the validation, verification, and accreditation during developmental testing.
  5. Assure the schedules of record for weapons integration, VSim, and mission data load production/verification are consistent with the Integrated Master Schedule.
  6. Continue with the OBIGGS redesign efforts to ensure the system has the capability to protect the aircraft from threat and lightning induced fuel tank explosions while on the ground and during all phases of a combat mission without compromised maneuver limits.
  7. Continue the PAO system redesign efforts and reinstall a PAO shutoff valve to protect the aircraft from PAO-based fires.
  8. Reconsider the removal of the fueldraulic fuses. The program should design and reinstate an effective engine fueldraulic shutoff system to protect the aircraft from fuel-induced fires.
  9. Reconsider the removal of a dry bay fire extinguisher system from other than the Integrated Power Package dry bay. Prior F-35 Live Fire testing showed that the fire suppression system could be designed to successfully extinguish fires from the most severe ballistic threats.
  10. Provide a higher-resolution estimate on how long the aircraft could continue to maintain controlled flight after a ballistic event. Remaining flight time, expressed in smaller time intervals (e.g., 30 seconds, 5 minutes, 30 minutes, etc.) is a more informative metric than the current “Loss of Aircraft” or “Return to FLOT” metric.

Global Command and Control System – Joint (GCCS-J)



Executive Summary

- Defense Information Systems Agency (DISA) development focused on implementing high priority capability enhancements, software corrections, and infrastructure improvements to both Global Command and Control System – Joint (GCCS-J) Global and Joint Operation Planning and Execution System (JOPES).

GCCS-J Global

- DISA developed GCCS-J Global v4.2.0.9 (Global v4.2.0.9) to provide operational enhancements, remediate security vulnerabilities, and correct Common Operational Picture (COP) and Integrated Imagery and Intelligence (I3) application deficiencies discovered while testing and operating previous Global releases. DISA expended significant effort to ensure Global v4.2.0.9 would be acceptable for fielding into the Air Operations Centers (AOCs) that support the Joint Force Air Component Commanders. Global v4.2.0.9 testing occurred at both the Combatant Command (CCMD) and AOC levels.
- CCMD-level testing:
  - The Joint Interoperability Test Command (JITC) conducted CCMD-level operational testing in December 2011, revealing substantially fewer defects than OT&E conducted during the past two years. However, due to known and encountered test limitations, operational testing was insufficient to determine operational effectiveness and suitability for both the CCMD and higher-echelon environments in which Global v4.2.0.9 will be used.
  - Regression testing of Global v4.2.0.9 Updates 1 and 2 conducted by DISA in 2012 showed the release was acceptable at CCMD and higher echelons. Four Category I deficiencies and 15 Category II deficiencies remain. Testing in the more demanding AOC environment is required to fully evaluate Global v4.2.0.9 corrections.
- AOC-level testing:
  - DOT&E used data collected during AOC-level developmental and operational testing, which implemented Global 4.2.0.9 in a more complex configuration, to assess Global v4.2.0.9 performance at lower echelons.
  - The Air Force conducted developmental testing at Langley AFB, Virginia, of Air Operations Center – Weapon System (AOC-WS) 10.1 Recurring Event (RE)11, which used Global v4.2.0.9 as a significant portion of RE11.
  - The 605th Test and Evaluation Squadron (TES) conducted a Force Development Evaluation (FDE) of RE11 with Global v4.2.0.9 Update 1, which revealed that most critical deficiencies had been fixed, but faster servers would be required to process the data demands of the AOC environment. Global v4.2.0.9 Update 1 testing occurred on upgraded servers, and showed a four-fold improvement in processing speed, satisfying AOC data demands.
  - 605th TES integrated developmental/operational testing of RE12 with Global v4.2.0.9 Update 2 in December 2012 is expected to address the remaining 4 Category I and 15 Category II deficiencies of Global v4.2.0.9 within the AOC environment.

GCCS-J JOPES

- DISA developed GCCS-J JOPES v4.2.0.2 (JOPES v4.2.0.2) to provide the initial framework for the Transportation Tracking Account Number (TTAN), to upgrade JOPES Data Network Services (JDNETS) software to reduce dependency on the Deliberate and Crisis Action Planning and Execution Segment (DCAPES) and support enhanced system monitoring, to resolve existing problem reports, and to upgrade commercial off-the-shelf (COTS) software.
- JITC conducted low-risk operational testing in February and March 2012 of JOPES v4.2.0.2 at five CCMD sites, three Service sites, the Joint Staff Support Center, and at the DISA Headquarters facility laboratories at Fort George G. Meade, Maryland. JOPES operational users validated the JOPES v4.2.0.2 capabilities during the execution of an end-to-end Time-Phased Force Deployment Data scenario.
  - The scenario demonstrated the ability to identify high-level mission requirements, source operational forces and materials, verify force and material availability and mission readiness, and schedule transportation to move those forces and materials.

- Decoupling of database exchanges between DCAPES and JOPES allowed each program to upgrade without affecting the other.
- Enhanced system monitoring allowed JOPES system administrators to better track JOPES system performance, such as transaction queues and query backlogs, across all four enclaves and deployable servers.

System
- GCCS-J is a command and control system utilizing communications, computers, and intelligence capabilities. The system consists of hardware, software (COTS and government off-the-shelf), procedures, standards, and interfaces that provide an integrated near real-time picture of the battlespace necessary to conduct joint and multi-national operations. GCCS-J consists of a client/server architecture using open systems standards, government-developed military planning software, and an increasing use of World Wide Web technology.
- GCCS-J consists of two main components:
  - Global v4.2.0.9 (Force Protection, Situational Awareness, Intelligence applications)
  - JOPES v4.2.0.2 (Force Employment, Projection, Planning, and Deployment/Redeployment applications)

Mission
- Joint Commanders utilize the GCCS-J to accomplish command and control.

GCCS-J Global
- Commanders use GCCS-J Global:
  - To link the National Command Authority to the Joint Task Force, Component Commanders, and Service unique systems at lower levels of command
  - To process, correlate, and display geographic track information integrated with available intelligence and environmental information to provide the user a fused battlespace picture
  - To provide I3 capabilities
  - To provide a missile warning and tracking capability
- The AOC uses GCCS-J Global:
  - To build the air picture portion of the COP and maintain its accuracy
  - To correlate or merge raw track data from multiple sources
  - To associate raw Electronics Intelligence data with track data
  - To perform targeting operations

GCCS-J JOPES
- Commanders use GCCS-J JOPES:
  - To translate policy decisions into operation plans (OPLANs) to meet U.S. requirements for the employment of military forces
  - To support force deployment, redeployment, retrograde, and reposturing
  - To conduct contingency and crisis action planning

Major Contractors
- Government Integrator: DISA
- Software Developers:
  - Northrop Grumman – Arlington, Virginia
  - SAIC – Arlington, Virginia
  - Pragmatics – Arlington, Virginia

Activity

GCCS-J Global
- DISA developed Global v4.2.0.9 to provide operational enhancements, remediate security vulnerabilities, and correct COP and I3 application deficiencies discovered while testing and operating previous Global releases. DISA expended significant effort to ensure Global v4.2.0.9 would be acceptable for fielding into the AOCs that support the Joint Force Air Component Commanders.
- Global 4.2.0.9 is a critical upgrade urgently needed by the AOC-WS program and the operational AOCs. The AOC-WS baseline uses legacy Global v4.0.2 and cannot employ critical I3 capabilities due to outstanding Category I problems when used in the AOC operational environment. Global v4.2.0.9 testing occurred at both the CCMD and AOC levels.
- CCMD-level testing:
  - JITC conducted operational testing of Global v4.2.0.9 at U.S. European Command and U.S. Southern Command in December 2011 in accordance with a DOT&E-approved test plan.
  - DISA conducted a regression test of Global v4.2.0.9 Update 1 in January and February 2012, after correction of deficiencies.
  - DISA conducted a regression test of Global v4.2.0.9 Update 2 in June 2012 after making corrections to additional deficiencies identified during Update 1 and RE11 testing.
- AOC-level testing:
  - The Air Force performed developmental testing of RE11 in January 2012 at Langley AFB, Virginia. A significant portion of this testing involved additional testing of the Global v4.2.0.9 baseline as it was approved by DISA for fielding within an AOC environment.
  - The 605th TES performed an FDE of RE11, to include the corrections in Global v4.2.0.9 Update 1, at Langley AFB in March 2012. Additional testing of

Global v4.2.0.9 Update 1, modified to work on newer, more powerful servers, occurred at Langley AFB in May 2012. During RE11, the 605th TES implemented Global v4.2.0.9 in a more complex configuration. This configuration has more live interfaces and the ability to load up to 30,000 active tracks into the battlespace picture, which was significantly more demanding than previous operational testing.
  - The 605th TES plans to test Global v4.2.0.9 Update 2 in an AOC environment in December 2012.

GCCS-J JOPES

- DISA developed JOPES v4.2.0.2 to provide the initial framework for TTAN, to upgrade JDNETS software to reduce dependency on DCAPES and support enhanced monitoring, to resolve existing problem reports, and to upgrade COTS software.
- JITC, in conjunction with the GCCS-J Program Office, conducted low-risk operational testing of JOPES v4.2.0.2 at five CCMD sites, three Service sites, the Joint Staff Support Center, and at the DISA Headquarters facility laboratories at Fort George G. Meade, Maryland. Testing occurred in February and March 2012.

GCCS-J SORTS

- DISA transitioned the GCCS-J Status of Resources and Training System (SORTS) component to the Defense Readiness Reporting System Implementation Office in late October 2011.

Assessment

GCCS-J Global

- DOT&E approved the JITC plan for operationally testing Global v4.2.0.9 for fielding to CCMD and higher-echelon locations, but not for fielding at lower-echelon sites such as AOCs. DOT&E is using operational test data collected during RE11 to adequately assess Global v4.2.0.9 performance at lower echelons.
- CCMD-level testing:
  - Results of JITC operational testing demonstrated significant improvement relative to past testing. Substantially fewer defects were discovered during the CCMD testing than was the case in nearly every OT&E conducted during the past two years. However, the aggregate of known and encountered test limitations rendered this test insufficient to determine operational effectiveness and suitability for both the CCMD and higher-echelon environments in which Global v4.2.0.9 will be used.
  - Many Global v4.2.0.9 interfaces were not available or tested at the two CCMD test locations, and stress levels for the COP and intelligence portion of GCCS-J are not operationally representative for AOC usage.
  - The CCMD COP loading was well below the 30,000 and 35,000 active tracks, with missile events, expected within the AOC environment.
  - Each CCMD location had only three to six intelligence users participating in the test, whereas lower-echelon locations may have over 100 users.
  - Regression testing in May 2012 showed that Global v4.2.0.9 Update 1 was acceptable at CCMD and higher echelons, albeit with 4 Category I and 15 Category II deficiencies requiring correction before fielding to AOCs. Regression testing on Update 1 demonstrated the ability of Global v4.2.0.9 Update 1 to handle the more demanding track loads experienced in the AOC environment.
  - DISA conducted regression testing of Global v4.2.0.9 Update 2 to validate corrections for 1 of 4 Category I and 10 of 15 Category II AOC deficiencies identified during Update 1 and RE11 testing. However, testing in an AOC environment is required to fully evaluate Global v4.2.0.9 corrections.
- AOC-level testing:
  - DOT&E used data collected at Langley AFB, Virginia, during developmental and operational testing of RE11, which used Global v4.2.0.9 as a significant portion of RE11, to assess Global v4.2.0.9 performance at lower echelons. RE11 offered a test environment more operationally representative of AOC usage and is expected to provide the remaining operational data needed to adequately assess the system once testing is complete.
  - Developmental testing of the RE11 revealed several critical deficiencies with the Global v4.2.0.9 baseline. JITC did not find these deficiencies during the earlier operational testing at the two CCMD sites due to test limitations. AOC users applied more stress to the Global COP and I3 application suite than was experienced at the CCMD test sites.
  - The FDE of RE11 with Global v4.2.0.9 Update 1 revealed that the most critical deficiencies had been fixed, but that faster servers would be required to process the data demands experienced in the AOC environment. Global v4.2.0.9 Update 1 was tested on upgraded servers, showing a four-fold improvement in processing speed and satisfying AOC data demands.
  - 605th TES integrated developmental/operational testing of RE12 with Global v4.2.0.9 Update 2 in December 2012 is expected to address the remaining 4 Category I and 15 Category II deficiencies of Global v4.2.0.9 within the AOC environment.

GCCS-J JOPES

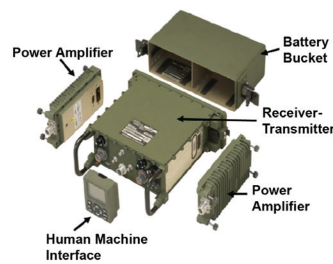
- JOPES operational users validated the JOPES v4.2.0.2 capabilities during the execution of an end-to-end Time-Phased Force Deployment Data scenario. JITC also observed DISA testers perform functional testing of the system to verify that system changes did not introduce new errors to the previously fielded software.

  - The supported CCMD identified high-level requirements for forces and materials to accomplish a particular OPLAN.
  - CCMD users sourced operational forces and materials to support the OPLAN, along with required timelines and locations.
  - CCMD users verified forces and material were available and mission-ready.
  - U.S. Transportation Command users scheduled transportation for the operational forces and materials to meet the supported CCMD requirements.
- TTAN implementation added new data fields, providing operational users with an initial capability to track the status of individuals and pieces of equipment for improved situational awareness. Upgrades to JDNETS web services did not adversely affect users' ability to monitor, plan, and execute mobilization, deployment, employment, and sustainment activities associated with joint operations. The upgrades to JDNETS improved JOPES administrator system-monitoring capabilities with an enhanced dashboard. Users successfully installed COTS software upgrades, following installation procedures, with no discrepancies noted.

Recommendations

- Status of Previous Recommendations. DISA addressed all previous recommendations.
- FY12 Recommendation.
  1. Operational testing of significant Global v4.2.0.9 upgrades will require testing by both CCMD and AOC communities to successfully address the significant test limitations encountered at the CCMD locations. Operational testing needs to include operationally representative stress levels by users, significant COP data processing of dynamically updating tracks, and live data flowing across all critical interfaces.

Joint Tactical Radio System (JTRS) Handheld, Manpack, and Small Form Fit (HMS) Manpack Radio



Executive Summary

- In May 2011, the Defense Acquisition Executive (DAE) approved a Milestone C Low-Rate Initial Production (LRIP) decision of 100 Manpack radios.
- In June 2011, the Army conducted a Manpack Limited User Test (LUT) as a part of its 2011 Network Integration Evaluation (NIE) 11.2. The Manpack radio demonstrated poor reliability, transmission range, and voice quality that restricted the unit's ability to accomplish its mission. These same problems were observed during previous developmental testing.
- In May 2012, the Deputy Assistant Secretary of Defense, Developmental Test and Evaluation (DASD DT&E) published a Manpack Assessment of Operational Test Readiness (AOTR) that stated the radio was not sufficiently mature to enter the planned Manpack Multi-Service Operational Test and Evaluation (MOT&E). DASD DT&E recommended that the Manpack radio not proceed to MOT&E to allow for corrective actions and additional developmental testing.
- In May 2012, the Army Test and Evaluation Command (ATEC) conducted the Manpack radio MOT&E as a part of its NIE 12.2. DOT&E assessed the Manpack radio as not operationally effective due to the poor performance of the Single Channel Ground and Airborne Radio System (SINCGARS) waveform and not operationally suitable due to a failure to meet reliability or availability requirements. The Manpack radio AOTR had outlined these major MOT&E deficiencies prior to operational test.
- In September 2012, the Army conducted a Government Development Test (GDT) 3 to demonstrate improvements in MOT&E deficiencies to support a planned 1QFY13 second LRIP decision.
- In October 2012, the DAE approved a second LRIP decision for 3,726 Manpack radios.
- The Joint Tactical Radio System (JTRS) Handheld, Manpack, and Small Form Fit (HMS) program is schedule-driven and has reduced developmental testing to support an aggressive operational test schedule. Operational testing continues to reveal problems that developmental testing should have identified and fixed.
- The Army continues preparation for a future Manpack radio MOT&E-2, which will include competition of Program of Record and alternate vendors.

System

- JTRS is a family of software-programmable and hardware-configurable digital radios intended to provide increased interoperability, flexibility, and adaptability to support numerous tactical communications requirements.
- The JTRS HMS program provides handheld and two-channel Manpack radios supporting Army, Marine Corps, Navy, and Air Force operations. The program develops Small Form Fit (SFF) radio configurations that include the stand-alone Army Rifleman Radio and embedded SFF variants that serve in Army host platforms such as the SFF-B (Shadow Unmanned Aerial Vehicle), SFF-B (V)1 (Nett Warrior), and the SFF-D (Small Unmanned Ground Vehicle).
- The program strategy has two phases of HMS production. The JTRS HMS program developed the Rifleman Radio as part of its Phase 1 effort to provide software programmable radios with National Security Agency (NSA) Type 2 encryption of unclassified information that could operate a networking waveform. Phase 2 consists of developing the Manpack radio to provide software programmable radios with NSA Type 1 encryption of classified information.
- The Manpack radio is a two-channel radio with military GPS that:
  - Is capable of operating at various transmission frequencies using the Soldier Radio Waveform (SRW), the SINCGARS waveform, and current military satellite communications waveforms. The JTRS HMS program intends to host the Mobile User Objective Satellite waveform on the Manpack radio as an objective capability.
  - Operates up to 20 watts at maximum power output.
  - Allows Soldiers to participate in doctrinal networks and transmit Position Location Information.

Mission

Commanders from the Army, Marine Corps, Navy, and Air Force use Manpack radios to:

- Communicate and create networks to exchange voice, video, and data using legacy waveforms or the SRW during all aspects of military operations.
- Integrate JTRS SFF variants into host platforms to provide networked communications capabilities for users engaged in land combat operations to support voice, video, and data across the air, land, and sea battlespace.

Major Contractor

General Dynamics, C4 Systems – Scottsdale, Arizona

Activity

- The Army conducted four developmental tests of the Manpack radio:
  - Manpack Customer Test, conducted at Fort Benning, Georgia, February 7 – 11, 2011.
  - Manpack GDT, conducted at the Electronic Proving Ground (EPG), Fort Huachuca, Arizona, April 15 – 22, 2011 (originally planned for 45 days).
  - Manpack GDT 2, conducted at the EPG, Fort Huachuca, Arizona, March 2 – 30, 2012.
  - Manpack GDT 3, conducted at the EPG, Fort Huachuca, Arizona, September 19 through October 3, 2012.
- In May 2011, the DAE approved a Milestone C LRIP decision to procure 100 Manpack radios of a total acquisition objective of 71,814 radios. The Manpack radio LRIP is intended to support future developmental and operational tests.
- In June 2011, the Army conducted the Manpack LUT as part of its NIE 11.2 at White Sands Missile Range, New Mexico. The Army used the LUT to assess the performance of the Manpack radio under numerous mission scenarios executed by a cavalry troop.
- In March 2012, the program conducted GDT 2 to assess the Manpack radio and verify fixes of deficiencies highlighted during the 2011 LUT.
- In May 2012, ATEC conducted the Manpack radio MOT&E as part of the Army's NIE 12.2 at White Sands Missile Range, New Mexico. ATEC tested the Manpack radio under various missions conducted by a motorized infantry company. Soldiers used the Joint Enterprise Network Manager to plan, load, and monitor the Manpack radio waveforms. The test was conducted in accordance with a DOT&E-approved test plan.
- The Army conducted a Manpack radio GDT 3, from September through October 2012. The test was intended to verify fixes to reliability and performance deficiencies found during the MOT&E and GDT 2.
- On October 11, 2012, the DAE approved a second LRIP for an additional 3,726 Manpack radios to increase the total LRIP procurement to 5 percent of the total acquisition objective.
- The Army is developing a JTRS HMS Manpack Radio Acquisition Strategy Report and Test and Evaluation Master Plan. These documents are required for future developmental and operational testing.

Assessment

- The Army reduced the first Manpack GDT (April 2011) from a scheduled 45 days to 8 days in order to place radios into the NIE 11.2 Manpack LUT.
- Both the Manpack Customer Test and GDT highlighted deficiencies in performance and poor reliability. The Army determined that the Manpack radio's SINCGARS waveform was not ready for test and therefore did not test it during the shortened GDT.
- During the NIE 11.2 Manpack LUT, the radio demonstrated the following:
  - Ability to transmit and receive on two channels
  - Ability to distribute Position Location Information throughout the network
  - Poor reliability
  - Poor transmission range performance of the SRW and SINCGARS waveforms that constricted the operational area of the cavalry troop
  - Inconsistent voice quality
  - SINCGARS waveform did not support unit operations and was immature for operational test
- The NIE 11.2 Manpack LUT reliability data collection was not adequate and not conducted in accordance with the DOT&E-approved test plan.
- The Manpack radio in GDT 2 demonstrated improved performance of the SRW, but the performance of the SINCGARS waveform and reliability were poor.
- In May 2012, DASD DT&E published a Manpack radio AOTR that stated the radio was not sufficiently mature to enter the planned MOT&E due to developmental test deficiencies that included poor reliability and an immature SINCGARS waveform. DASD DT&E recommended that the Manpack radio not proceed to MOT&E to allow for corrective actions and more developmental testing.
- Based on the NIE 12.2 Manpack radio MOT&E, DOT&E made the following assessment:
  - Not operationally effective due to the poor voice quality and limited range of the SINCGARS waveform compared to legacy SINCGARS radios. Since the SINCGARS performance was poor, the company leadership resorted to using satellite-based chat communications of the Blue Force Tracker.

- The SRW performance was good and the Soldiers were able to employ the Manpack radio for intra-company voice and data communications.
- Not operationally suitable due to a failure to meet reliability and availability thresholds.
- No waveform met the Army's reliability requirement. The SRW was the most used waveform and demonstrated a reliability of 163 hours Mean Time Between Essential Function Failure (MTBEFF) compared to the radio's revised requirement of 477 hours. This translates to a 63 percent chance of completing a 72-hour mission compared to a requirement of 86 percent.
- No waveform met the availability requirement. The SRW achieved an operational availability of 0.86 compared to a 0.96 requirement.
- The radio's design allowed Soldiers to accidentally zero the Manpack radio. This action erases all radio presets and communications security, and requires 20 – 25 minutes to restore the Manpack radio to operation.
- The Army's integration of the radios into Mine Resistant Ambush Protected vehicles was poor and reduced the radio's performance. The program did not test vehicle integration in developmental testing prior to the MOT&E.

• During GDT 3, the Manpack radio demonstrated:
  - Improved performance of the SINCGARS waveform that met requirements of mounted and dismounted transmission range, voice quality, and call completion rates under benign conditions of developmental test.
  - Poor reliability with the SRW waveform demonstrating 177 hours MTBEFF compared to the Manpack requirement of 477 hours. This translates to a 66 percent chance of completing a 72-hour mission compared to a requirement of 86 percent.

• The Army continues preparation for a future Manpack radio MOT&E-2, which will include competition of Program of Record and alternate vendors.
• The JTRS HMS program is schedule-driven and has reduced time for developmental testing to support an aggressive operational test schedule.

Recommendations

• Status of Previous Recommendations. The JTRS HMS program did not address the previous recommendations to perform adequate developmental testing prior to operational testing and to complete necessary documentation to support developmental and operational testing.
• FY12 Recommendations. The Army should:
  1. Ensure that adequate developmental testing is performed prior to future operational tests.
  2. Correct any JTRS HMS deficiencies noted at the May 2012 Manpack radio MOT&E prior to the scheduled MOT&E-2.
  3. Perform a holistic reliability growth analysis to rigorously assess Manpack radio maturity and to provide the information needed to develop a detailed plan for achieving required reliability.
  4. Complete necessary Manpack radio documentation to support future developmental and operational testing.

Joint Tactical Radio System (JTRS) Handheld, Manpack, and Small Form Fit (HMS) Rifleman Radio

Executive Summary

- In January 2011, the Army conducted a Verification of Correction of Deficiencies (VCD) test with a redesigned version of the Rifleman Radio. During the VCD test, Soldiers demonstrated that the redesigned Rifleman Radio corrects most of the radio's deficiencies and provides some improvement to reliability.
- In May 2011, the Joint Tactical Radio System (JTRS) Handheld, Manpack, and Small Form Fit (HMS) program received a Milestone C Low-Rate Initial Production (LRIP) decision based upon the improved performance the Rifleman Radio demonstrated during the VCD. The Defense Acquisition Executive (DAE) approved the Rifleman Radio LRIP quantity of 6,250 radios.
- In November 2011, the Army conducted a Rifleman Radio IOT&E intended to support a Full-Rate Production decision as a part of the Network Integration Evaluation 12.1. DOT&E assessed the Rifleman Radio to be operationally effective with poor reliability.
- From February through April 2012, the Army conducted Governmental Developmental Test (GDT) 2.3 and GDT 2.3a to complete developmental testing normally completed prior to IOT&E. During GDT 2.3, the Rifleman Radio demonstrated new failures not observed in IOT&E. The program performed a software update and demonstrated fixes during GDT 2.3a. The Rifleman Radio showed improvement but did not meet its reliability requirement.
- In May 2012, the DAE decided to pursue a competitive Full-Rate Production decision and approved a second LRIP decision for 13,077 radios.
- The JTRS HMS program is schedule-driven and did not complete developmental testing prior to IOT&E to support an aggressive operational test schedule. Operational testing has continued to reveal problems that should have been discovered and fixed during developmental testing.

System

- JTRS is a family of software-programmable and hardware configurable digital radios intended to provide increased interoperability, flexibility, and adaptability to support numerous tactical communications requirements.
- The JTRS HMS program provides handheld and two-channel Manpack radios supporting Army, Marine Corps, Navy, and Air Force operations. The program develops Small Form Fit (SFF) radio configurations that include the stand-alone Army Rifleman Radio and embedded SFF variants that serve in Army host platforms such as the SFF-B (Shadow Unmanned Aerial Vehicle), SFF-B (V)1 (Nett Warrior), and the SFF-D (Small Unmanned Ground Vehicle).

- The program strategy has two phases of HMS production. The JTRS HMS program developed the Rifleman Radio as part of its Phase 1 effort to provide software programmable radios with National Security Agency (NSA) Type 2 encryption of unclassified information that could operate a networking waveform. Phase 2 consists of developing the Manpack radio to provide software programmable radios with NSA Type 1 encryption of classified information.
- The Rifleman Radio is a one-channel radio with commercial GPS that:
  - Is capable of operating at various transmission frequencies using the Soldier Radio Waveform (SRW)
  - Operates at 5 watts maximum power output
  - Allows Soldiers to participate in Army doctrinal voice networks and transmit Position Location Information

Mission

Army leaders and Soldiers use Rifleman Radios to communicate and create networks to exchange voice, video, and data using the SRW during all aspects of military operations.

Major Contractor

General Dynamics, C4 Systems – Scottsdale, Arizona

Activity

- The JTRS HMS program completed a redesign of the Rifleman Radio hardware and improved its software to address deficiencies identified during the 2009 Limited User Test. The redesigned Rifleman Radio features improvements in size, weight, battery life, and increased radio frequency power output.
- In January 2011, the Army conducted a Rifleman Radio VCD test at Fort Benning, Georgia, to demonstrate improvements in the redesigned radio.
- In May 2011, the DAE approved a Milestone C LRIP decision to procure 6,250 Rifleman Radios of a total acquisition objective of 193,279 radios.
- From October to November 2011, the Army Test and Evaluation Command conducted the Rifleman Radio IOT&E at White Sands Missile Range, New Mexico, as part of the Army's Network Integration Evaluation 12.1. The test was conducted in accordance with a DOT&E-approved test plan. Operational units tested the Rifleman Radio using the Soldier Radio Waveform Network Manager (SRWNM) to plan and load SRW network configurations into the radios. Two platoons of infantry engaged in a variety of mission scenarios employed the Rifleman Radio. An additional baseline infantry platoon, equipped with legacy radios, completed similar missions for comparison purposes.
- February through March 2012, the Army conducted the Rifleman Radio GDT 2.3 at the Electronic Proving Ground at Fort Huachuca, Arizona. The Army conducted this GDT to complete developmental testing that the Army should have completed prior to IOT&E.
- In April 2012, the Army conducted a follow-on developmental test, GDT 2.3a. The Army used this follow-on event to confirm fixes to deficiencies observed during GDT 2.3.
- On May 23, 2012, the DAE approved a second LRIP for an additional 13,077 Rifleman Radios to increase the total LRIP procurement to 10 percent of the total acquisition objective.
- The Army continues preparation for a future Rifleman Radio IOT&E-2 that will include competition of Program of Record and alternate radio vendors.

Assessment

- During the 2009 Rifleman Radio Limited User Test, DOT&E assessed the radio as useful during mission preparation, movement, and reconnaissance activities. The radio demonstrated poor performance during combat operations and poor reliability.
- During the 2011 Rifleman Radio VCD test, the redesigned radio demonstrated the following improvements:
  - Operational reliability of 277 hours Mean Time Between Essential Function Failure (MTBEFF) compared to the revised requirement of 477 hours. This translates to a 92 percent chance of completing a 24-hour mission compared to a requirement of 95 percent.
  - Transmission range met the radio's requirement of 2,000 meters in an urban setting and 1,000 meters in dense vegetation.
  - Radio battery life exceeded the radio's revised 8-hour requirement.
- During the 2011 Rifleman Radio IOT&E, the production-representative radio demonstrated the following:
  - Usefulness in supporting combat leaders and Soldiers in a wide variety of missions.
  - Enhanced ability for Soldiers to execute mission command and communicate using voice and data.
  - Increased effective radio transmission range relative to legacy radios.
  - Reduced reliability of 161 hours MTBEFF compared to the requirement of 477 hours. This translates to an 86 percent chance of completion of a 24-hour mission compared to a requirement of 95 percent.
  - Vulnerabilities in Information Assurance and electronic warfare.
- During the 2011 Rifleman Radio IOT&E, the SRWNM did not support the unit's mission in planning and loading radios in a timely manner due to cumbersome software and poor training provided to Soldiers.
- During the 2012 GDT 2.3, the Rifleman Radio demonstrated reliability of 157 hours MTBEFF. This reduced reliability was due to new failures (not observed in IOT&E) that included spontaneous reboots, loss of the ability to transmit, or loss of the ability to receive. The program attributed these failures to software updates. The JTRS HMS program updated the software and performed GDT 2.3a to demonstrate fixes.
- The Rifleman Radio during the GDT 2.3 and 2.3a demonstrated the following results:
  - Estimated reliability of the Rifleman Radio is 310 hours MTBEFF, which is a 93 percent chance of completing a 24-hour mission against a 95 percent requirement.
  - Message completion rate of 84 percent and a call completion rate of 95 percent. The Army's requirement for both is 90 percent.
  - The radio met its requirements for Position Location Information updates, size, weight, power, and retention of cryptographic information.
- The Rifleman Radio program is schedule-driven. As a result, the Army did not perform the necessary developmental testing required to ensure success during the Rifleman Radio IOT&E. Although the first developmental test event was conducted prior to IOT&E, the Army conducted the remaining two developmental test events several months after the operational test.

Recommendations

- Status of Previous Recommendations. The JTRS HMS program did not address the previous recommendations to perform adequate developmental testing prior to operational testing and to complete necessary documentation to support future developmental and operational testing.
- FY12 Recommendations. The Army should address the previous recommendations and:
  1. Ensure that adequate developmental testing is performed prior to future operational tests.
  2. Complete necessary Rifleman Radio documentation to support future developmental and operational testing.

Joint Tactical Radio System (JTRS) Network Enterprise Domain (NED) Network Managers

Executive Summary

- Joint Tactical Radio System (JTRS) Enterprise Network Manger (JENM) runs both the JTRS Wideband Networking Waveform (WNW) Network Manager (JWNM) and the Soldier Radio Waveform (SRW) Network Manager (SRWNM). JENM allows signal personnel to manage the networks of JTRS software-defined radio sets.
- Of the JENM management functions (planning, loading, monitoring, controlling, and reporting) SRWNM and JENM/SRWNM testing examined the planning, loading, and monitoring functions.

SRWNM

- The Navy's Commander, Operational Test and Evaluation Force (COTF) conducted operational testing from October through November 2011. Based on results from testing, DOT&E issued an Operational Assessment report in August 2012 assessing SRWNM as not capable of supporting the unit's mission and unreliable in supporting JTRS Rifleman Radio. The SRWNM lacks the capability needed for Soldiers to use it quickly and effectively to configure a network. The Army had not developed the tactics, techniques, and procedures needed for Soldiers to employ the SRWNM in support of units using Rifleman Radios during combat operations.

JENM/SRWNM

- In a July 2012 Operational Assessment report, DOT&E assessed JENM/SRWNM as effective and suitable in support of JTRS Manpack radios operating the SRW in part due to applying the lessons learned from the SRWNM IOT&E. Soldiers also used JENM/SRWNM to successfully load Rifleman Radios as part of the Army's Network Integration Evaluation (NIE) activities. Lessons learned from the SRWNM IOT&E applied during the JENM/SRWNM IOT&E included improvements to Soldier training, development and validation of the network plan, and concept of operations for loading and configuring the Manpack radios for the MOT&E.
- The test unit successfully used JENM/SRWNM to import a network plan, load the radios, and monitor the SRW network. However, Soldiers reported the monitoring capability had limited utility.

System

- JTRS Network Enterprise Domain (NED) software applications allow the JTRS software-defined radio sets to provide communications to tactical forces. The software applications include waveforms, enterprise networking services (route and retransmission among waveforms), and enterprise network management.

- The waveforms and enterprise networking services software are integrated into and are considered part of a JTRS radio set, and their performance is part of that reported for the JTRS Handheld, Manpack, and Small Form Fit (HMS); and Airborne, Maritime, and Fixed Station (AMF) radio products.
- The enterprise network management software is separate from the JTRS radio sets and is deployed on designated commercial off-the-shelf laptop computers.
  - The current network manager products are: JWNM for managing WNW networks; and SRWNM for managing SRW networks of JTRS software-defined radio sets.
  - In FY12, the JTRS NED Program Office integrated SRWNM onto the JENM. In the near future, the Program Office intends to integrate both JWNM and SRWNM onto a single JENM laptop computer.
  - Enterprise network management functions include planning, loading, monitoring, controlling, and reporting.
  - The planning function develops the network parameters and creates a Radio Mission Data Set file.
  - The loading function transfers the Radio Mission Data Set file into the HMS or AMF radio sets to configure them.
  - The monitoring function provides a near real-time display of the WNW or SRW network status and the conditions of the radios.
  - The controlling function allows the signal Soldier to make changes to the network, to include sending commands to the radio operator, changing the configuration parameters

of the radio sets, or conducting cryptographic functions (rekey, zeroize, and transfer).
- The reporting function records all network management events and makes the data available for analysis.

Mission
- Forward-deployed military forces use JTRS radios to communicate and create networks to exchange voice, video, and data during all aspects of tactical military operations.
- Signal staffs use the JENM to plan, load, monitor, control, and report on network operations involving JTRS HMS and AMF software-defined radio sets, as well as non-developmental item radios, running WNW and SRW.

Major Contractors
- The Boeing Company, Phantom Works Division – Huntington Beach, California (the JWNM and JENM developer)
- ITT Electronics Systems Division – Clifton, New Jersey (the SRWNM developer)

Activity
- DOT&E approved the JTRS NED Test and Evaluation Master Plan in July 2011.

SRWNM
- DOT&E approved the SRWNM IOT&E plan on October 7, 2011.
- COTF conducted the SRWNM IOT&E in support of the Rifleman Radio IOT&E from October through November 2011. Problems with the network plan and use of SRWNM began to affect the start date for the Rifleman Radio IOT&E. Contractor support was used to correct the plan and reload the radios to ensure the Rifleman Radio test would start on time. As a result, the SRWNM test was not conducted in accordance with the DOT&E-approved test plan.

JENM/SRWNM
- DOT&E approved the JENM/SRWNM IOT&E plan on March 29, 2012.
- COTF conducted the JENM/SRWNM IOT&E as described in the DOT&E-approved test plan in support of the Army's NIE 12.2 and Manpack radio IOT&E in April and May 2012.
- The JTRS NED Program Office integrated the SRWNM software onto the JENM platform following the Rifleman Radio IOT&E (referred to as JENM/SRWNM).

JENM
- The JTRS NED Program Office continues development of the JENM, which will integrate the JWNM and SRWNM into a single network management product in FY13.

Assessment

SRWNM
- SRWNM developmental testing in FY11 confirmed the system's capability to plan networks, create mission data sets, and then load mission data sets for the Rifleman Radios loaded with the SRW. Per the Army concept of operations, there is no requirement for SRWNM to monitor the Rifleman Radio / SRW network, so this function was not demonstrated in the SRWNM IOT&E.
- DOT&E assessed SRWNM as not capable of supporting the unit's mission and the system demonstrated poor reliability in support of the Rifleman Radio. Soldiers could not use SRWNM to quickly and effectively configure a network. The Army had not developed adequate training or the necessary tactics, techniques, and procedures for Soldiers to employ the SRWNM in support of units using Rifleman Radios during combat operations.
- Shortfalls in the capability and use of SRWNM include the following:
  - Lack of troubleshooting procedures
  - Lack of a network plan validation event or process
  - Excessive time needed to load Rifleman Radios
  - Lack of procedures to distribute configured radios by mission
  - Lack of flexible radio configurations to support changing missions
- The single signal Soldier in the company was overwhelmed by the sheer amount of communications equipment he was responsible for operating and maintaining.

JENM/SRWNM
- DOT&E assessed JENM/SRWNM as effective and suitable in support of Manpack radios operating the SRW.
- Lessons learned from the SRWNM IOT&E were applied to the training, development, and validation of the network plan and concept of operations for loading and configuring Manpack radios. Soldiers using JENM/SRWNM also demonstrated the ability to successfully load Rifleman Radios as part of NIE activities.
  - The test unit successfully used JENM/SRWNM to import a network plan, load the radios, and monitor the SRW network. However, Soldiers reported the monitoring capability had limited utility.
  - Operational challenges with the use of JENM/SRWNM still exist. The process for planning and loading a network is cumbersome and time consuming (about 20-25 minutes per radio). This time includes several steps that include radio start up, loading the plan, loading the crypto keys, and checking the communications link. For the test, the company had 46 Manpack radios and 96 Rifleman Radios. In total, it took two Soldiers two to three days to load and check all the radios.

- Dynamic task organization remains an operational deficiency because of the length of time it takes to change radio presets to match the task organization. The brigade estimated it would take 48 hours to modify the radio presets in the plan and reload all the radios with the new plan to allow the task organization of a single platoon to a different company.
- The JENM/SRWNM had no significant reliability problems. The JENM/SRWNM IOT&E results demonstrated that the software and hardware improvements corrected the deficiencies noted in the previous SRWNM IOT&E. Training was much better than that experienced in the previous SRWNM IOT&E based on Soldier input, but Soldiers reported that they would like to see more practical exercises and documented processes in future training.
- The single signal Soldier in the company was overwhelmed by the sheer amount of communications equipment he was responsible for operating and maintaining.
- Development and verification of the JTRS networks is a significant undertaking. The Army must determine who is going to develop the SRW network architecture/communication plans and translate those into JENM files and radio configuration files for the multi-Service units to be equipped with Manpack radios. It is not clear whether the Program Office can sustain the level of effort required to construct the needed inputs for each unit as JTRS radios are fielded across the force.

Recommendations

- Status of Previous Recommendations. The Army addressed two of the three recommendations for FY11. There is still no movement on developing an integrated test methodology for JENM developmental and operational testing. With the closing of the JTRS Joint Program Executive Office and the radio programs now all under separate program management, resolving this FY11 recommendation is critical to ensure JENM is properly tested.
- FY12 Recommendations. The Army should:
  1. Evaluate the force structure implications of adding JTRS radios and network management responsibilities into company-level organizations. The single signal Soldier in the company was overwhelmed by the sheer amount of communications equipment he was responsible for operating and maintaining.
  2. Determine who is going to develop the WNW and SRW network architecture/communications plans, and then translate those into JENM files and radio configuration files for the multi-Service units to be equipped with Manpack, Rifleman, and AMF radios.

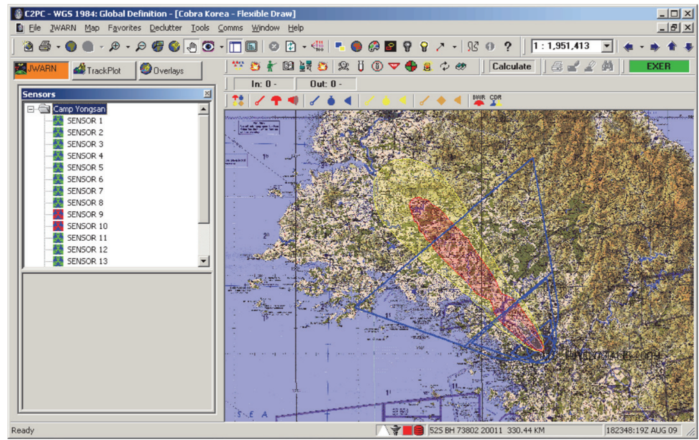
Joint Warning and Reporting Network (JWARN)

Executive Summary

- Joint Warning and Reporting Network (JWARN) software hosted on Global Command and Control System (GCCS) – Maritime is an operationally effective automated Chemical, Biological, Radiological, and Nuclear (CBRN) warning, reporting, and analysis tool for Navy operations to send warning reports to units at risk from a CBRN hazard in time to take protective action when the units are more than 10 kilometers downwind. The Navy should upgrade the GCCS – Joint version currently employed at its Maritime Operations Centers to GCCS – Joint with Plain Language Address (PLA) capability to utilize JWARN to send timely warning messages between battle groups and to other Services when ships are employing emissions control procedures.
- Based on FOT&E results, JWARN software hosted on GCCS – Maritime is operationally suitable and reliable. Operators with JWARN new equipment training are able to successfully execute basic-level analysis and reporting scenarios. During FOT&E, JWARN operators lost situational awareness during more complex CBRN attack scenarios and did not send appropriate and timely hazard warning reports.
- The JWARN Program Office should develop and field computer-based training that includes basic to advanced scenario exercises to increase operator skills and provide sustainment training.

System

- JWARN is a joint automated CBRN warning, reporting, and analysis software tool that resides on joint and Service command and control systems such as the GCCS – Army, GCCS – Joint, GCCS – Maritime, and Command and Control Personal Computer/Joint Tactical Common Workstation, or stand-alone computers.
- JWARN software automates the NATO CBRN warning and reporting process to increase the speed and accuracy of information sharing to support force protection decision making and situational awareness.
- JWARN uses the Common Operating Picture of the host command and control network to display ground maps; unit locations; location of CBRN events; and the predicted or actual location of hazards to support the Commanders' situational awareness and response capability.



Mission

JWARN operators in command cells support CBRN force protection, battlefield management, and operational planning by predicting chemical, biological, and nuclear hazard areas based on sensor and observer reports, identifying affected units and operating areas, and transmitting warning reports.

Major Contractor

Northrop Grumman Mission Systems – Orlando, Florida

Activity

- The Army Test and Evaluation Command and the Navy's Commander, Operational Test and Evaluation Force conducted follow-on operational testing of the JWARN hosted on GCCS – Maritime from June 25 – 29, 2012, at the Space and Naval Warfare Systems Center Pacific computer laboratory, in accordance with the DOT&E-approved operational test plan.
- DOT&E approved an updated Test and Evaluation Master Plan on March 19, 2012, to address follow-on developmental and operational testing of the JWARN when hosted on GCCS – Maritime.
- The program conducted developmental and reliability growth testing to demonstrate readiness for follow-on operational testing at the Space and Naval Warfare Systems Center Pacific computer laboratory in San Diego, California, from November to December 2011 with JWARN hosted on GCCS – Maritime and GCCS – Joint with PLA.
- DOT&E approved the JWARN follow-on operational test plan on June 5, 2012.

Assessment

- JWARN software hosted on GCCS – Maritime provides an operationally effective automated CBRN warning, reporting, and analysis tool to send warning reports to units at risk from a CBRN hazard in time to take protective action if the units are more than 10 kilometers downwind for the initial hazard.
- During normal operations, U.S. Navy Expeditionary Strike Groups can exchange CBRN hazard warnings and reports with Navy Maritime Operations Centers for communication across the naval fleet and Services using JWARN and GCCS host e-mail capability. When ships are employing emissions control procedures to avoid being located by the enemy, e-mail capability is shut down. Ships in emissions control mode are able to send CBRN JWARN hazard warnings and reports using GCCS-Maritime PLA text messaging capability.
- The version of GCCS – Joint used by Navy Maritime Operations Centers does not have PLA capability. JWARN is not compatible with the current legacy software used by Navy Maritime Operations Centers to send PLA text messages. Personnel at the Navy's Maritime Operations Centers must manually enter information from JWARN reports into a legacy system with PLA capability to send CBRN warnings and reports to ships employing emission control procedures. This presents an opportunity for transcription errors and creates a delay that may cause CBRN warning messages to reach ships at risk too late to implement effective protective actions.
- During FOT&E, operators using JWARN demonstrated interoperability with a developmental version of GCCS – Joint with PLA capability. Fielding GCCS – Joint with PLA capability at Navy Maritime Operations Centers would speed delivery of CBRN warning messages when ships are implementing emissions control measures and are unable to receive e-mail communications.
- JWARN software hosted on GCCS – Maritime is operationally suitable. The JWARN software hosted on GCCS – Maritime is reliable. Operators with new equipment training are able to successfully execute basic-level analysis and reporting scenarios. However, JWARN operators require advanced training in order to successfully execute CBRN analysis and reporting when faced with complex CBRN attack scenarios.

Recommendations

- Status of Previous Recommendations. The program manager addressed all previous recommendations.
- FY12 Recommendations.

1. The Navy should work with the GCCS program to coordinate deployment of GCCS – Joint with PLA capability to Maritime Operations Centers with deployment of GCCS – Maritime (with JWARN).
2. The program manager should develop and field computer-based training that includes basic to advanced scenario exercises to increase operator skills and provide sustainment training.

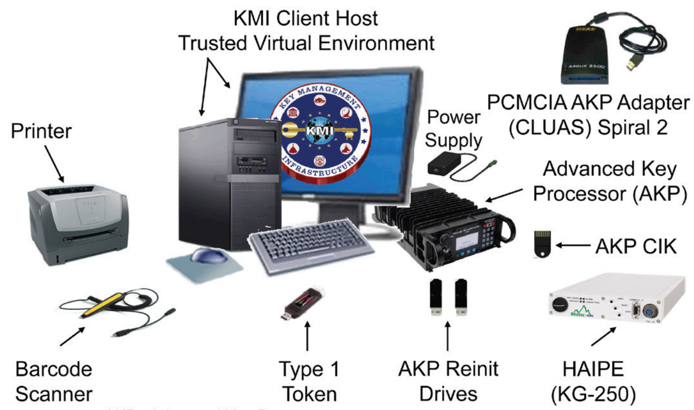
Key Management Infrastructure (KMI)

Executive Summary

- In January 2012, the Key Management Infrastructure (KMI) Program Management Office (PMO) and DoD Chief Information Officer (CIO) declared an acquisition cost and schedule threshold breach, resulting in a Critical Change Review of the program. Subsequently, the Chairman of the Joint Chiefs of Staff declared KMI essential to national security and OSD recertified the program to Congress.
- The Joint Interoperability Test Command (JITC) conducted an IOT&E from July until August 2012. The results were a marked improvement over previous operational assessments; however, there were still several operational effectiveness and suitability problems uncovered during the testing event that must be corrected before continued deployment.
- The KMI transition process and Services' fielding concepts must be matured to ensure an accurate and smooth migration from the legacy Electronic Key Management System (EKMS) to KMI. Configuration management controls and training of personnel at the KMI operational support site need improvement to eliminate system inconsistencies.
- The new Type 1 token hardware and its stability are an improvement over previous tokens, but its reliability is deficient and further product refinement and testing is necessary for a suitability determination.
- KMI is potentially operationally effective once significant transition problems are resolved. Security is undetermined, pending a Red Team's assessment. KMI is interoperable and received full certification for Spiral 1; however, KMI was determined to be unsuitable due to the lack of help desk preparedness for operational support, deficient token reliability, and immature Configuration Control Board and configuration management processes.
- Despite problems identified during operational testing, the KMI program continues to show progress toward delivering a useful cryptographic capability for system managers and users. Operational users in the IOT&E reviewed the system capabilities positively, once the transition process completed.

System

- KMI is intended to replace the legacy EKMS to provide a means for securely ordering, generating, producing, distributing, managing, and auditing cryptographic products (e.g., asymmetric key, symmetric keys, manual cryptographic systems, and cryptographic applications).
- KMI Spiral 1 consists of core nodes that provide web operations at a single site operated by the National Security Agency (NSA), as well as individual client nodes distributed globally to provide secure key and software provisioning services for the DoD, intelligence community, and agencies. Spiral 2 will provide improved capability through software enhancements to the Spiral 1 baseline.



AKP - Advanced Key Processor
CIK - Crypto Ignition Key
CLUAS - Card Loader User Application Software
HAIPE - High Assurance Internet Protocol Encryptor
PCMCIA - Personal Computer Memory Card International Association
Reinit - Reinitialization

- KMI combines substantial custom software and hardware development with commercial off-the-shelf (COTS) computer components. The custom hardware includes an Advanced Key Processor for autonomous cryptographic key generation and a Type 1 user token for role-based user authentication. The COTS components providing user operations include a client host computer, High Assurance Internet Protocol Encryptor (KG-250), monitor, keyboard, mouse, printer, and barcode scanner.

Mission

- Combatant Commands, Services, DoD agencies, other Federal government agencies, coalition partners, and allies will use KMI to provide secure and interoperable cryptographic key generation, distribution, and management capabilities to support mission-critical systems, the Global Information Grid, and initiatives such as Cryptographic Modernization.
- Service members will use KMI cryptographic products and services to enable security services (confidentiality, non repudiation, authentication, and source authentication) for diverse systems such as Identification Friend-or-Foe, GPS, Advanced Extremely High Frequency Satellite System, Joint Tactical Radio System, and Warfighter Information Network – Tactical.

Major Contractors

- SAIC – Columbia, Maryland (Spiral 2 Prime)
- General Dynamics Information Assurance Division – Needham, Massachusetts (Spiral 1 Prime)
- BAE Systems – Linthicum, Maryland
- L3 Systems – Camden, New Jersey
- SafeNet – Belcamp, Maryland
- Praxis Engineering – Annapolis Junction, Maryland

Activity

- DOT&E published the KMI Operational Assessment-2 report in mid-October 2011. Based on that report, the DoD CIO approved Milestone C and authorized the KMI program to enter the Production, Deployment, and Sustainment phase for Capability Increment 2 in late October 2011.
- In January 2012, the KMI PMO and DoD CIO declared an acquisition cost and schedule threshold breach, resulting in a Critical Change Review of the program. Subsequently, the Chairman of the Joint Chiefs of Staff declared KMI essential to national security and OSD recertified the program to Congress.
- With the DoD CIO certification of the program, the KMI Program Office moved forward with Spiral 1 IOT&E preparations and Spiral 2 Contract Award.
- In accordance with the Acquisition Decision Memorandum, the KMI program manager implemented a token reliability growth program and conducted accelerated life testing of 120 tokens in order to increase confidence in token reliability. The tokens achieved 86,000 combined hours of testing while undergoing temperature and vibration cycles to demonstrate a 10,000-hour Mean Time Between Failure with 80 percent confidence.
- The KMI program and JITC conducted an IOT&E in accordance with a DOT&E-approved plan from July 9 through August 10, 2012, at 17 separate Service and Agency locations across the United States.
- DOT&E published the KMI IOT&E report in mid-October 2012.

Assessment

- KMI is potentially operationally effective once significant transition problems are resolved. Security is undetermined, pending a Red Team's assessment. KMI is interoperable and received full certification for Spiral 1; however, KMI was determined to be unsuitable due to the lack of help desk preparedness for operational support, deficient token reliability, and immature Configuration Control Board and configuration management processes.
- Successful completion of IOT&E was required for a Spiral 1 client node fielding decision.
  - The program's major hardware developmental item, the Advanced Key Processor, is performing well and exceeds its expected reliability.
  - The Service and agency users perceived KMI as a major qualitative improvement over the legacy EKMS.
- KMI is significantly more stable and usable than in previous test events, although there are still effectiveness and suitability problems with transition and backend support.
- Based on the IOT&E, problems with system performance, data errors, manual KG-250 and virtual private network tunnel configurations, and network connectivity associated with account transition affected the efficacy and speed of migrating cryptographic products from EKMS to KMI. This caused significant delays in account migration across Services and agencies.
- The 5 percent token failure rate observed during the test period is not acceptable. While observations indicate that token reliability is improved, additional token reliability testing to gain more usage hours, square wave (power cycling), and mechanical insertion testing is required.
- Symmetric cryptographic key ordering is working well in KMI; however, asymmetric keys are ordered within KMI but their production is accomplished external to the system. While this is an early delivery solution to support Service needs, operational users can still effectively perform their duties.
- Suitability concerns persist with the system and logistical support documentation. These products are improved, but they require refinement to support a fully operational capability.
- KMI help desk and system administration personnel were not adequately prepared to support a fully operational KMI system.
  - The monitoring capabilities and knowledge base are immature and not well-exercised. Critical support personnel were not prepared to support the user community during transition and day-to-day operations.
  - The backend support is not prepared for a KMI full fielding effort. Significant effort must be made to refine the technical support processes before the system is fully deployed to hundreds of user accounts and client systems.
- The Configuration Control Board processes and procedures for updating and implementing system builds and maintaining a consistent software baseline are not refined or effectively implemented to support the Services and agencies.
- The KMI transition process and Services' fielding concepts must be matured to ensure an accurate and smooth migration from the legacy EKMS to KMI. Configuration management controls and training of personnel at the KMI operational support site needs improvement to eliminate system inconsistencies.
- KMI system documentation, procedures, and training for technical staff and help desk personnel are inadequate. However, KMI operational users indicated the training was thorough but too compressed. The Services have limited training blocks to two weeks because of Reservist and National Guard requirements.
- Despite some problems identified during operational testing, the KMI program continues to show steady progress toward delivering a useful cryptographic capability for system managers and users. Operational users in the IOT&E reviewed the system capabilities positively, once the transition process completed.
- Based on the IOT&E results, the KMI PMO scheduled an FOT&E for January 2013.

Recommendations

- Status of Previous Recommendations. The KMI PMO satisfactorily addressed seven of nine previous recommendations. Additional PMO effort is required to adequately address regression testing for system builds and their deployment and more time is necessary to provide adequate KMI training.
- FY12 Recommendations. The KMI PMO should:
  1. Require the developmental contractors to routinely demonstrate system readiness through regression testing before releasing software upgrades and system builds, and then only as approved by the Configuration Control Board for distribution to Services and agencies.
  2. Review Service and agency deployment methods and work jointly to automate transition functions, such as KG-250 and virtual private network tunnel configurations, to reduce problems and minimize network setup changes and remote troubleshooting from the KMI support site.
  3. Capture and refine documentation of all KMI process adjustments for incorporation in system and user-level operating guides.
  4. Assure that KMI training includes sufficient hands-on equipment time to allow users to gain more system familiarity, knowledge, and proficiency. Additional user and manager-level training is needed to ensure that users can understand the KMI processes and operate the system.
  5. Conduct additional token reliability testing incorporating more usage hours, square wave (power cycling), and mechanical insertion tests.

Mine Resistant Ambush Protected (MRAP) Family of Vehicles

Executive Summary

- The program procured 250 Navistar Dash Ambulances to fulfill an urgent need to provide protected transport and urgent medical treatment for Army units in Afghanistan.
- The Army Test and Evaluation Command (ATEC) completed the Limited User Test (LUT) of the Dash Ambulance with the Independent Suspension System (ISS) in November 2011 at Yuma Proving Ground, Arizona, in accordance with the DOT&E-approved test plan.
- DOT&E provided an Operational Assessment of the Dash Ambulance in August 2012.
- The Dash Ambulance is not operationally effective and not operationally suitable.
  - The patient compartment of the vehicle is small and the litter births are not long enough to safely accommodate litter patients taller than 5 feet 11 inches. A unit equipped with the Dash Ambulance cannot provide safe emergency medical care and transport for tall casualties in close proximity to enemy forces.
  - The small interior of the Dash Ambulance does not provide sufficient space for medical equipment and inhibits the ability of the medic to maneuver within the compartment to properly treat patients.
  - Loading patients in the Dash Ambulance is hampered due to difficulty aligning and securing the litter onto the litter rail system.
- The Dash Ambulance is reliable. During the Dash Ambulance LUT, the vehicle demonstrated 796 Mean Miles Between Operational Mission Failure (MMBOMF) versus its operational requirement of 600 MMBOMF. The vehicle can be maintained by Soldiers and is recoverable.
- The Dash Ambulance is survivable. The vehicle met the MRAP Capabilities Document version 1.1 threshold underbody and under-wheel blast requirements.
- The MRAP program procured 2,071 Caiman Multi-Terrain Vehicle (CMTV) rolling chassis with ISS and Caiman Underbody Blasts Kits to address crew vulnerability and mobility deficiencies. This variant is undergoing developmental testing. Underbody blast testing of an early version of the CMTV showed a significant reduction of the crew to injuries over the baseline Caiman.
- The Joint Program Office MRAP will transfer management responsibilities to the Services on October 2013.

NAVISTAR Dash Ambulance

BAE Caiman Multi-Terrain Vehicle Category II

System

- MRAP is a family of vehicles designed to provide increased crew protection and vehicle survivability against current battlefield threats, such as IEDs, mines, and small arms. The DoD initiated the MRAP program in response to an urgent operational need to meet multi-Service ground vehicle requirements. MRAP vehicles provide improved vehicle and crew survivability over the High Mobility Multi-purpose Wheeled Vehicle (HMMWV). The MRAPs are employed by units in current combat operations in the execution of missions previously accomplished with the HMMWV. This report covers two MRAP vehicles:
  - Navistar Dash Ambulance with ISS
  - BAE CMTV Category II
- The Navistar Dash ISS Ambulance variant is designed to transport up to two litter patients or four ambulatory casualties.
- The BAE CMTV Category II is designed to transport 10 persons plus 1 gunner.
- MRAP vehicles incorporate current Service command and control systems and counter-IED systems. MRAP vehicles have gun mounts with gunner protection kits capable of mounting any one of a variety of weapons systems such as the M240B medium machine gun, the M2 .50 caliber heavy machine gun, and the Mk 19 grenade launcher.

Mission

Units equipped with CMTV conduct small unit combat operations such as mounted patrol, convoy security, troop, and cargo transportation. The unit equipped with the MRAP Dash Ambulance variant supports the conduct of medical treatment and evacuation.

Major Contractors

- BAE Tactical Vehicle Systems (TVS) – Sealy, Texas
- Navistar Defense – Warrenville, Illinois

Activity

- The MRAP program continued to acquire and test enhanced capabilities to integrate across the MRAP family of vehicles. In FY12, the major capability insertions include the ambulance kits for the Navistar Dash and the ISS for the BAE CMTV.
- The MRAP program procured 2,071 CMTV rolling chassis with ISS and Caiman Underbody Blasts Kits to address crew vulnerability and mobility deficiencies. This variant is undergoing developmental testing. Live Fire testing of the CMTV will commence in 2QFY13.
- The program procured 250 Navistar Dash Ambulances.
- In November 2011, ATEC completed a LUT of the Dash Ambulance with ISS at Yuma Proving Ground, Arizona, in accordance with the DOT&E-approved test plan.
- DOT&E provided an Operational Assessment of the Dash Ambulance in August 2012.
- The program is developing, procuring, and integrating the Army network capabilities onto MRAP vehicles.
- The Joint Program Office MRAP will transfer management responsibilities to the Services in October 2013.

Assessment

- The Dash Ambulance is not operationally effective and not operationally suitable. The patient compartment of the vehicle is small and the litter births are not long enough to safely accommodate litter patients taller than 5 feet 11 inches. A unit equipped with the Dash Ambulance cannot provide safe emergency medical care and transport for tall casualties in close proximity to enemy forces. This problem should have been corrected prior to the LUT.
- The small interior of the Dash Ambulance does not provide sufficient space for medical equipment and inhibits the ability of the medic to maneuver within the compartment to properly treat patients.
- Loading patients in the Dash Ambulance is hampered due to difficulty aligning and securing the litter onto the litter rail system.
- The Dash Ambulance is reliable. During the Dash Ambulance LUT, the vehicle demonstrated 796 MMBOMF versus its operational requirement of 600 MMBOMF. The vehicle can be maintained by Soldiers and is recoverable
- The Dash Ambulance is survivable. The vehicle met the MRAP Capabilities Document version 1.1 threshold underbody and under-wheel blast requirements.
- Based on performance during developmental testing, the CMTV cannot stop following sustained operations in muddy terrain. The program suspended developmental testing until the program identifies and implements a materiel solution to fix the brake system.
- Endurance testing of the CMTV is ongoing at Yuma Proving Ground, Arizona, in all conditions except wet off-road. Underbody blast testing of an early version of the CMTV showed a significant reduction of the crew to injuries over the baseline Caiman. The CMTV experienced problems associated with air conditioner, tire, and new cab mount cracking failures. The program should resolve these problems prior to conducting FOT&E.
- Planning for Live Fire testing of the CMTV is ongoing and testing will commence in FY13.

Recommendations

- Status of Previous Recommendations. The Army has not addressed the recommendation to improve the cross-country mobility and system reliability of the Navistar MRAP Recovery Vehicle.
- FY12 Recommendations for the Dash Ambulance and the CMTV. Prior to conducting FOT&E, the program should:
  1. Redesign the Dash Ambulance to accommodate litter patients taller than 5 feet 11 inches. Review the installed medical equipment with the objective of providing additional internal space and reducing patient loading time.
  2. Fix the CMTV brake system to allow the vehicle to stop in muddy conditions and improve the overall reliability of the CMTV.

Mine Resistant Ambush Protected (MRAP) All-Terrain Vehicle (M-ATV)

Executive Summary

- The Mine Resistant Ambush Protected (MRAP) All-Terrain Vehicle (M-ATV) with Underbody Improvement Kit (UIK) participated in the Dash MRAP Ambulance Limited User Test (LUT) in November 2011 at Yuma Proving Ground, Arizona, in accordance with the DOT&E-approved test plan.
- DOT&E provided an Operational Assessment of the M-ATV with UIK in August 2012.
- The M-ATV with UIK is operationally effective, operationally suitable, and survivable.
  - A unit equipped with the M-ATV with UIK can accomplish tactical transport missions.
  - The M-ATV with UIK provides sufficient armored mobility to conduct missions over the type of terrain typically found in Afghanistan.
  - The M-ATV with UIK demonstrated off-road mobility and maneuver capability similar to the base M-ATV during the MRAP Dash Ambulance LUT. The M-ATV with UIK met its reliability, operational availability, and maintainability requirements based on the LUT.
  - The M-ATV with UIK meets the level for improved protection against underbody blast threats specified in the Joint Urgent Operational Need Statement.
- In October 2014, the Joint Program Office (JPO) MRAP will transition management of the of the Special Operations Forces (SOF) M-ATV fleet to the Services.
- United States Special Operations Command (USSOCOM) is planning an FOT&E of the SOF M-ATV in 2QFY13.

System

- The M-ATV is designed for five passenger positions including a gunner. The vehicle incorporates current Service command and control and counter-IED systems. The M-ATV includes gun mounts with gunner protection kits capable of mounting a variety of weapons systems such as the M240B medium machine gun, the M2 .50 caliber heavy machine gun, and the Mk 19 grenade launcher.

M-ATV with Underbody Improvement Kit (UIK)

Special Operations Forces M-ATV UIK

- The M-ATV has the capability to add protection against attacks by explosively formed penetrators, and rocket-propelled grenades to support mounted patrols, reconnaissance, security, and convoy protection.
- USSOCOM required modifications to the Army M-ATV to support SOF missions. The modifications included five passenger positions including a gunner, protection for the cargo area, rear area access, and some other improvements for human factors.
- The M-ATV with UIK and SOF M-ATV UIK are designed to provide improved underbody blast protection to the M-ATV variants.

Mission

Multi-service and special operations units equipped with the M-ATV conduct mounted patrols, convoy patrols, convoy protection, reconnaissance, and communications, as well as command and control missions to support combat and stability operations in highly restricted rural, mountainous, and urban terrain.

Major Contractor

Oshkosh Defense – Oshkosh, Wisconsin

Activity

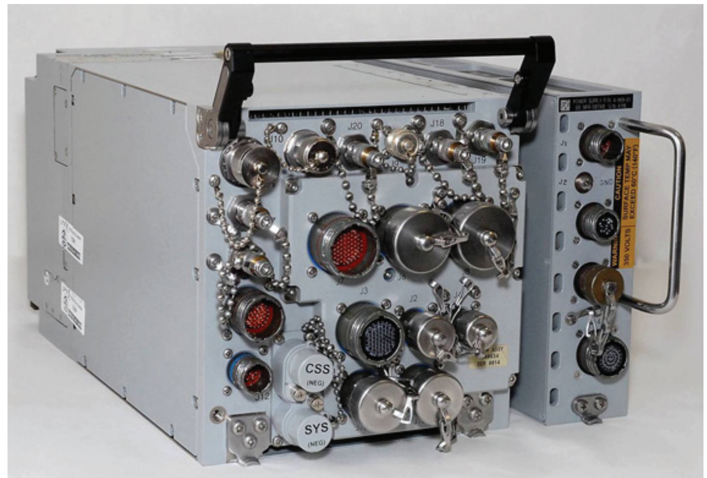
- The M-ATV with UIK participated in the Dash MRAP Ambulance LUT in November 2011 at Yuma Proving Ground, Arizona, in accordance with the DOT&E-approved test plan.
- In FY12, the program integrated the SOF-specific UIK onto the SOF M-ATV fleet to improve SOF M-ATV underbody blast protection.
- DOT&E provided an Operational Assessment of the M-ATV with UIK in August 2012.
- USSOCOM completed the developmental test weapons firing event of the SOF M-ATV with the Common Remotely Operated Weapon Station (CROWS) at Fort Campbell, Kentucky, in April 2012 to examine the capability to fire the

Mk 19 grenade machine gun with the CROWS integrated on the SOF M-ATV in an operational environment.
- The program is developing, procuring, and integrating the Army network capabilities onto base M-ATVs.
- The SOF M-ATV UIK Live Fire testing was completed in August 2012.
- In October 2014, the JPO MRAP will transition management of the SOF M-ATV fleet to the Services.
- USSOCOM is planning an FOT&E of the SOF M-ATV in 2QFY13.

Assessment
- The M-ATV with UIK is operationally effective, operationally suitable, and survivable. A unit equipped with the M-ATV with UIK can accomplish tactical transport missions. The M-ATV with UIK provides sufficient armored mobility to conduct missions over the type of terrain typically found in Afghanistan.
- The M-ATV with UIK demonstrated off-road mobility and maneuver capability similar to the base M-ATV during the MRAP Dash Ambulance LUT. The M-ATV with UIK met its reliability, operational availability, and maintainability requirements based on the LUT.
- The M-ATV with UIK meets the level for improved protection against underbody blast threats specified in the Joint Urgent Operational Need Statement.
- During developmental test weapons firing of the SOF M-ATV, no CROWS/SOF M-ATV integration failures were observed after firing approximately 480 rounds of high-explosive dual-purpose ammunition. Four weapon-firing failures were attributed to operator error indicating more CROWS and weapon proficiency training is needed before FOT&E.

Recommendations
- Status of Previous Recommendations. USSOCOM has addressed two of the three previous SOF M-ATV recommendations. USSOCOM did not address the recommendation related to improving the visibility of the SOF passenger by installing larger rear windows in SOF M-ATV.
- FY12 Recommendation.
  1. USSOCOM should continue to plan and conduct the SOF M-ATV FOT&E.

Multi-functional Information Distribution System (MIDS) Joint Tactical Radio System (JTRS)



Executive Summary

- The Navy completed the Verification of Correction of Deficiencies (VCD) operational test of the Multi-functional Information Distribution System Joint Tactical Radio System (MIDS JTRS) core terminal as integrated into the F/A-18E/F in December 2011.
- DOT&E published a MIDS JTRS VCD report in March 2012. DOT&E determined that testing was adequate to indicate that the MIDS JTRS, integrated into the F/A-18E/F, was now operationally effective and operationally suitable. Major deficiencies discovered during the 2010 IOT&E, including ineffective Link 16 message exchange and fine synchronization, as well as terminal and host platform integrated system reliability, have been resolved.
- The Air Force completed operational testing of the MIDS JTRS core terminal integration into the E-8C Joint Surveillance and Target Attack Radar System (JSTARS) aircraft in September 2011. DOT&E assessed that MIDS JTRS as integrated in the E-8 JSTARS is operationally effective and suitable with limitations.
- The Navy is continuing development of two major increments of MIDS JTRS capability that will improve datalink performance: Link 16 four-channel Concurrent Multi-Netting with Concurrent Retention Receive (CMN-4) and Tactical Targeting Networking Technology (TTNT). These new capabilities may require significant hardware and software design changes to the MIDS JTRS core terminal, as well as modifications to host platforms. DOT&E and the Navy are formulating the test strategies for these new MIDS JTRS terminal designs and their integration into host platforms.

System

- When integrated into a host platform, MIDS JTRS provides Link 16 digital datalink, Link 16 digital voice communications, and Tactical Air Navigation (TACAN) capabilities, plus three additional programmable channels capable of hosting additional JTRS Software Communications Architecture-compliant waveforms in the 2 to 2,000 Megahertz radio frequency band. In addition, MIDS JTRS is intended to provide the capability for Link 16 enhanced throughput and Link 16 frequency re-mapping.
- Link 16 digital datalink is a joint and allied secure anti-jam high-speed datalink that uses standard messages to exchange information among flight or battle-group host platforms or between combat platforms and command and control systems. Link 16 digital voice provides host platforms with a secure anti-jam voice line-of-sight communications capability. TACAN is a legacy aircraft navigation system used in many military aircraft with air-to-air as well as air-to-ground modes of operation.
- The system includes the MIDS terminals and the host platform components and interfaces such as controls, displays, antennas, high-power amplifiers, and any radio frequency notch filters.
- The MIDS JTRS terminals developed to conduct Concurrent Multi-Net Reception are intended to have improved digital receivers, improved buffering, and faster processors to allow host aircraft to receive more Link 16 messages during periods of high message exchange demand.
- The Navy intends for the MIDS JTRS terminals under development to utilize the multiband capability of the MIDS JTRS to provide Link 16 and TTNT to the host platform. The Navy intends for TTNT to provide a larger throughput with lower latency, thereby enabling faster updates of precise information than Link 16 with expanded radio frequency coverage. The Navy intends to use TTNT as one of the communications enablers for the Naval Integrated Fire Control – Counter Air capability.

Mission

U.S. Services and many allied nations will deploy aircraft, ships, and ground units equipped with MIDS JTRS in order to provide military commanders with the ability to communicate with their forces by voice, video, and data during all aspects of military operations. MIDS JTRS-equipped units are intended to exchange information including air and surface tracks, identification, host platform fuel, weapons, mission status, engagement orders, targeting data, and engagement results.

Major Contractors

- ViaSat, Inc. – Carlsbad, California
- Data Link Solutions – Wayne, New Jersey and Cedar Rapids, Iowa

Activity

- The Navy's Commander, Operational Test and Evaluation Force completed the VCD test of the MIDS JTRS, as integrated on the F/A-18E/F, operating from the Naval Air Warfare Center China Lake, California, and during deployed detachments to Naval Air Station Fallon, Nevada, during December 2011.
- The Air Force's 605th Test and Evaluation Squadron (TES) conducted a Force Development Evaluation of the JSTARS Communications and Network Upgrade Phase 1, which includes the MIDS JTRS integration, from June to September 2011. This evaluation took place at Patuxent River Naval Air Station, Maryland, in the U.S. Southern Command Joint Interagency Task Force – South area of responsibility, and at the JSTARS Test Force and Northrop Grumman Corporation facilities in Melbourne, Florida. All testing was conducted in accordance with DOT&E-approved Test and Evaluation Master Plans and operational test plans. DOT&E published a MIDS JTRS VCD report in March 2012.
- DOT&E and the Navy are formulating the test strategies and revising TEMPs for new MIDS JTRS terminal designs and their integration into host platforms. These designs include Link 16 four-channel Concurrent Multi-Netting with CMN-4 and TTNT.

Assessment

- The FY12 DOT&E MIDS JTRS VCD indicated improved Link 16 message exchange compared to the 2010 IOT&E result. DOT&E determined that the MIDS JTRS, as integrated into the F/A-18E/F, was now operationally effective and operationally suitable.
- Testing indicated that Link 16 messages provided situational awareness of friendly force positions and intentions. These messages were consistently and accurately exchanged with 100 percent success during air-to-air missions. The test data also indicated a 99 percent successful ability to obtain Link 16 fine synchronization compared to the IOT&E result of 84 percent.
- The test data indicated that terminal and host platform integration reliability had improved relative to IOT&E. System reliability improved to 21.6 hours between critical failures compared to 8.1 hours during the IOT&E. Operational availability had improved to 99 percent compared to 68 percent during the IOT&E.
- The built-in test false alarm rate of 1 false alarm every 5.9 flight hours failed to meet the threshold requirement of 1 false alarm every 113 flight hours.
- DOT&E found the integration of the MIDS JTRS core terminal into the E-8C JSTARS operationally effective and operationally suitable with limitations. The system was effective in transmitting Link 16 datalink and voice communications. JSTARS had no MIDS JTRS terminal failures in 114.3 hours accumulated during testing, but terminal operators experienced display anomalies. The JSTARS Program Office plans to fix the display anomalies in the next upgrade cycle.
- New capabilities such as Link 16 four-channel Concurrent Multi-Netting with CMN-4 and TTNT may require significant hardware and software design changes to the MIDS JTRS core terminal, as well as modifications to host platforms to integrate the new TTNT capability.

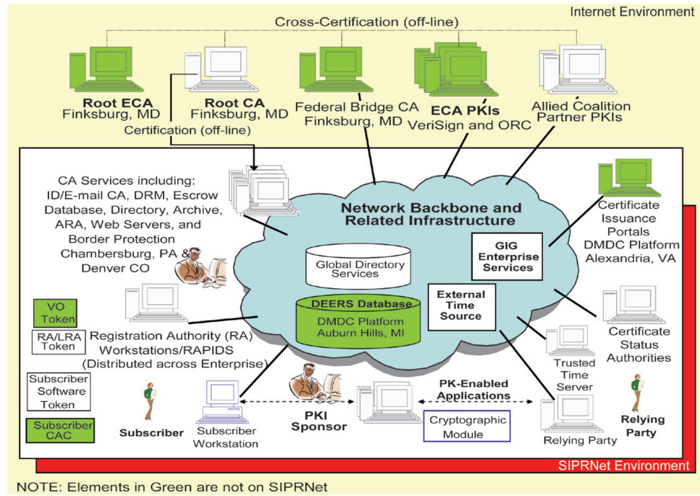
Recommendations

- Status of Previous Recommendations. The Navy and the MIDS Program Office made satisfactory progress on the previous recommendations related to the correction of deficiencies identified during the IOT&E.
- FY12 Recommendations. The Navy should:
  1. Continue software design efforts to reduce the incidence of built-in test false alarms and plan a maintenance demonstration to include an exhaustive evaluation of failure diagnostics prior to the start of the operational test of the Link 16 Concurrent Multi-Net Reception capability.
  2. Adopt a Design of Experiments approach to the test strategies and include a reliability growth analysis/plan as TEMP revisions occur for future MIDS JTRS capability increments. Conduct a thorough review of the manufacturing process of the terminal with new capabilities to verify the new production-representative terminals will be stable during operational testing.

Public Key Infrastructure (PKI)

Executive Summary

- DoD Public Key Infrastructure (PKI) Increment 2 provides authenticated identity management via password-protected Secret Internet Protocol Routing Network (SIPRNET) tokens to enable DoD members and others to access the SIPRNET securely and encrypt and digitally sign e-mail. Full implementation will enable authorized users and non-person entity (NPE)-enabled devices (e.g., servers and workstations) to access restricted websites and enroll in online services.
- An IOT&E in 2011 exposed significant logistics deficiencies due to undefined processes for procuring, distributing, and tracking SIPRNET tokens. The Defense Manpower Data Center, which currently handles the common access card (CAC) logistical processes on the Non-secure Internet Protocol Router Network (NIPRNET), is actively working with the DoD PKI Program Management Office (PMO) to take on similar responsibilities for the SIPRNET tokens.
- In October 2011, the DoD Chief Information Officer (CIO) directed the military Services and agencies to implement PKI on the SIPRNET and deploy tokens DoD-wide to approximately 500,000 users by December 31, 2012. As of mid-October 2012, military Services and agencies had issued approximately 78,300 tokens to users, falling far short of the pace needed to achieve the 500,000 goal by end of year. This status reflects growing backlogs in registering, enrolling, and getting SIPRNET tokens out to users, suggesting only nominal improvements toward overall SIPRNET security.
- In January 2012, the DoD CIO approved full fielding of PKI to the SIPRNET and tactical environments and the acquisition of the necessary tokens, card readers, and software to support fielding. The DoD CIO called for an operational retest of end-to-end logistical processes to address outstanding suitability deficiencies.
- In September 2012, the Joint Interoperability Test Command (JITC) conducted an operational test of a bulk token formatting and issuance capability intended to improve the speed of token issuance. JITC found the formatter to be effective and suitable, fulfilling its intended purpose by providing the Registration Authorities the ability to simultaneously complete multiple tasks. Fifteen SIPRNET token bulk formatters are currently being used by the Services and an additional 35 units are being procured.
- Capabilities to correct logistic shortfalls with token inventory and accounting are delayed and awaiting operational testing. A previously scheduled FOT&E slipped from 3QFY12 until 2QFY13 to verify correction of logistics deficiencies found during the IOT&E. JITC intends to conduct an operational test to verify whether the new Inventory Logistics System (ILS) can successfully track tokens by serial number and location throughout their lifecycle from ordering, through shipping, issuing, and return. Future enhanced reporting capabilities to improve token accounting and reporting will not be available for operational testing until 1QFY14.



NOTE: Elements in Green are not on SIPRNet

ARA - Auto-key Recovery Agent
CA - Certification Authority
CAC - Commom Access Card
DEERS - Defense Enrollment Eligibility Reporting System
DMDC - Defense Manpower Data Center
DRM - Data Recovery Manager
ECA - Enterprise Certification Authority
GIG - Global Information Grid
ID - Identification
LRA - Local Registration Authority
ORC - Operational Research Consultants, Inc.
PK - Public Key
RA - Registration Authority
RAPIDS - Real-Time Automated Personnel Identification System
SIPRNet - SECRET Internet Protocol Router Network
VO - Verifying Official

System

- DoD PKI is a critical enabling technology for Information Assurance (IA). It supports the secure flow of information across the Global Information Grid as well as secure local storage of information.
- DoD PKI provides for the generation, production, distribution, control, revocation, recovery, and tracking of Public Key certificates and their corresponding private keys.
- DoD PKI is comprised of commercial off-the-shelf hardware and software, and other applications developed by the National Security Agency (NSA).
  - The Defense Enrollment Eligibility Reporting System (DEERS) and the Secret DEERS provide the personnel data for certificates imprinted on NIPRNET CACs and SIPRNET tokens respectively.
  - DoD PKI Certification Authorities for the NIPRNET and SIPRNET tokens reside in the Defense Information Systems Agency (DISA) Enterprise Service Centers in Chambersburg, Pennsylvania, and Oklahoma City, Oklahoma.
  - DISA and NSA are jointly developing DoD PKI in multiple increments. Increment 1 is complete and

deployed on the NIPRNET. Increment 2 is being developed and deployed in three spirals on the SIPRNET and NIPRNET to deliver the infrastructure, PKI services and products, and logistical support for Spiral 1 (tokens), Spiral 2 (tactical and austere environments), and Spiral 3 (NPE PKI, Federal and coalition capabilities).

- The NPE development effort provides certificates for devices, automated and manual enrollment, and the infrastructure means for credential checking to insure NPE-enabled devices (e.g., domain controllers, web servers, and workstations) are authorized to exist on DoD networks.

Mission

- Military operators, communities of interest, and other authorized users will use DoD PKI to securely access, process, store, transport, and use information, applications, and networks regardless of technology, organization, or location.
- Commanders at all levels will use DoD PKI to provide authenticated identity management via personal identification number-protected CACs or SIPRNET tokens to enable DoD members, coalition partners, and others to access restricted websites, enroll in online services, and encrypt and digitally sign e-mail.

Major Contractors

- General Dynamics Information Technology – Needham, Massachusetts (Prime)
- 90Meter – Newport Beach, California
- SafeNet – Belcamp, Maryland

Activity

- In September 2011, the PKI PMO signed a Memorandum of Agreement with the Defense Manpower Data Center to develop an ILS to handle SIPRNET token ordering, shipping, and distribution.
- In October 2011, the DoD CIO directed the military Services and Agencies to implement PKI on the SIPRNET and deploy tokens DoD-wide to all users by December 31, 2012.
- The JITC and PMO executed an automated failover in December 2011. The failover between the PKI systems in Chambersburg, Pennsylvania, and Oklahoma City, Oklahoma, demonstrated continuity of operations after the planned failover.
- DOT&E issued the PKI Increment 1, Spirals 1 and 2 IOT&E report on December 6, 2011.
- In January 2012, the DoD CIO approved full fielding of PKI to the SIPRNET and tactical environments and the acquisition of the necessary tokens, card readers, and software to support fielding. The DoD CIO called for an operational retest of end-to-end logistical processes to address outstanding suitability deficiencies.
- The PKI PMO continues to work on the underlying suitability problems, focusing on the ILS and Token Management System to address scalability. However, no significant PKI capabilities were delivered and operationally tested in FY12. Suitability retesting is ready but on hold due to errors in reconciling token inventory status for tokens already issued.
- Test planning and preparations are ongoing for conducting an operational test of Increment 2, Spiral 3 backend capabilities in December 2012.
- With approval from the DoD CIO, the PKI PMO further delayed the NPE capability delivery and operational assessment until 3QFY13 due to security and user concerns that the proposed capability will not satisfy current mission requirements. Security mitigations are being developed and plans for testing the proposed NPE capability are being put in place.

Assessment

- The PKI Increment 2, Spirals 1 and 2 IOT&E were conducted in 4QFY11 in accordance with a DOT&E-approved test plan.
- The DOT&E report in December 2011 found the system to be operationally effective and secure, but not operationally suitable with logistical improvements needed to support full deployment. The system was available, reliable, maintainable, and relatively easy to use. However, critical logistical support deficiencies were found in the processes for distributing and accounting for hardware tokens, token readers, and middleware. Specific logistics deficiencies found include the following:
  - The lack of a robust token reliability tracking program for ensuring failure rates are acceptable.
  - A centralized token inventory system for ensuring tokens are procured and distributed according to Service and agency demands and for tracking tokens that are reissued to different users.
  - The need for more customized searching and reporting through the Token Management System portal interface to enable Services and Agencies to better report on token issuance status.
  - The lack of bulk formatting and issuance capabilities to improve token distribution time and reduce manpower costs.
- While logistics improvements have been made since the IOT&E report, to include delivery of a bulk formatting and issuance capability, a final tested robust logistics process for token procuring, distributing, tracking, and reporting is not in place. Delays in the delivery of the centralized logistics inventory system coupled with the Services' need to meet the DoD CIO's SIPRNET token deployment directive are hampering the transition from previous operations.
- There are over 530,000 SIPRNET tokens distributed to the Services and Agencies but only 78,300 tokens in use as of mid-October 2012. This status reflects the significant backlog in registering, enrolling, and deploying SIPRNET tokens. The

Service and agency registration authorities responsible for issuing tokens currently do not have the manpower needed to support the FY13 NPE operational test activities. Additionally, stakeholders do not have enough confidence in the NPE capability because it has not been adequately demonstrated via developmental testing. Ongoing missions and operations are precluding the Services and agencies from being able to commit critical devices to operational assessments and testing.

- Overall, the PKI system and technical capabilities are sound, but the SIPRNET standard operating procedures, training, logistical support, and lifecycle sustainment lack maturity. While procedures for middleware and card reader distribution and support have improved, the new process supporting the token ILS has not yet been demonstrated. Additional duties are being defined within the PKI program for Service and agency token warehouse and issuance site managers to ensure that tokens are properly tracked by the new system. With more than 100 issuance sites, there is a significant risk that the ILS process will not be uniformly adopted in a timely manner, which is necessary to provide a complete and accurate inventory status and to enable production of tokens based on issuance site requirements.
- The NPE capability delays continue to plague the Program Office. The NPE delivery is now amassed into the Increment 2, Spiral 3 set of capabilities, which also include enhancements to the existing SIPRNET and NIPRNET infrastructures. While the NPE Release 3 provides some automation improvements, it adds a substantial manpower support requirement for the Services to accomplish the large volume of DoD NPE devices, especially given the loose DoD guidance stating that all devices require medium assurance certificates. The registration authorities and system administrators ultimately responsible for approving and enrolling devices into the system have major concerns with the system and the workload it will entail. Although the PKI PMO has attempted to refine guidance to enable NPE certificate deployment to be prioritized based on risk that a device can be compromised by information attacks, the community has not established a clear path forward for deploying NPE certificates across DoD devices.
- The developmental test program is inadequate to support integrated test planning efforts. Processes and procedures directed in both the Test and Evaluation Master Plan and System Engineering Plan have not been implemented, which has resulted in limited visibility into actual performance of the system. Better coordination between the test teams, and improved test planning and reporting are required to support operational test readiness assessments.
- Overly aggressive testing event dates continue to waste critical user and test resources by forcing the assessment of PKI capabilities that are not ready to be assessed.

Recommendations

- Status of Previous Recommendations. The PKI PMO satisfactorily addressed five of seven recommendations from the FY11 Annual Report for Increment 2, Spirals 1 and 2. The recommendations concerning correction of token testing and scheduling deficiencies remain.
- FY12 Recommendations.
  1. The PKI program needs to improve coordination with the stakeholders, provide better capability definition, and recognize schedule impossibilities early to provide sound acquisition management for testing and delivering the PKI capabilities for the DoD.
  2. The PKI program needs to adhere to both the System Engineering Plan and Test and Evaluation Master Plan, which provide specific direction on how the development and testing of the PKI capabilities should be executed.
  3. The PKI acquisition community needs clear guidance on the intended NPE devices. Any directives for issuing NPE certificates must take into consideration Service and agency manpower and resource constraints. If such guidance is not timely, the PKI acquisition program baseline should be restructured such that tests are driven based on capability maturity, readiness, and mission need and not to satisfy program schedule requirements.
  4. The PMO should work to establish a more realistic timeline for PKI development, delivery, and capability testing that better supports milestone decisions. The program must better manage expectations of those with PKI equities by avoiding recurring schedule slips caused by capability delivery delays.

Army Programs

Army Programs

Network Integration Evaluation (NIE)

In FY12, the Army continued execution of a series of Network Integration Evaluations (NIEs), which began in FY11 with NIE 11.2. The purpose of the NIEs is to provide a venue for operational testing of Army acquisition programs, with a particular focus on the integrated testing of programs related to tactical mission command networks. Additionally, the NIEs are intended to serve as a venue for evaluating emerging capabilities that are not formal acquisition programs. This fiscal year the Army executed two NIEs, both at Fort Bliss, Texas, and White Sands Missile Range, New Mexico. NIE 12.1 was conducted from October through November 2011 and NIE 12.2 was conducted from April through May 2012.

The intended objective of the NIE to test and evaluate network components together in a combined event is sound. The NIE events should allow for a more comprehensive evaluation of an integrated mission command network, instead of piecemeal evaluations of individual network components. Conducting NIEs two times a year creates an opportunity for event-driven operational testing as opposed to schedule-driven testing. For example, if a system was not developmentally ready to enter operational testing at one NIE event, it would have the opportunity to enter testing in a subsequent NIE event.

The Army intends to conduct NIE events approximately every six months for the foreseeable future.

NIE 12.1.

During NIE 12.1, the Joint Tactical Radio System (JTRS) Handheld, Manpack, and Small Form Fit (HMS) Rifleman Radio underwent an IOT&E. The Army also executed an operational assessment of the AN/PRC-117G radio. (Individual articles providing assessments of the Rifleman Radio and the AN/PRC-117G can be found later in this Annual Report).

During NIE 12.1, the Army conducted evaluations of 47 additional systems in various stages of development. These systems, termed by the Army as "systems under evaluation" (SUEs), are not acquisition programs of record, but rather systems that may offer value for future development.

NIE 12.2

During NIE 12.2, the Army conducted a Multi-Service Operational Test and Evaluation (MOT&E) for the JTRS HMS Manpack radio and IOT&Es for Warfighter Information Network – Tactical (WIN-T) Increment 2 and JTRS Enterprise Network Manager. (Individual articles on these programs are provided later in this Annual Report.) The Army also conducted assessments of 36 SUEs.

NIE ASSESSMENT

Overall, the Army's execution of the NIEs has shown steady improvement since NIE 11.2, which was reported on in the FY11 Annual Report. The Army has incorporated lessons learned from previous events. This was reflected in NIE 12.2, which was the best planned and executed NIE of the three conducted to date.

Operational Scenarios and Test Design. The Brigade Modernization Command, in conjunction with the Army Test and Evaluation Command's Operational Test Command, continues to develop realistic, well designed operational scenarios for use during NIEs. NIE 12.2 contained the most challenging mission set to date, including Combined Arms Maneuver for the first time in any significant way. NIE 12.2 stressed brigade and battalion command and control to a much greater degree than did previous NIEs. Unlike in previous NIEs, all Tactical Operations Centers and command posts in NIE 12.2 displaced multiple times. Additionally, as part of the WIN-T Increment 2 testing, NIE 12.2 included units not located at Fort Bliss or White Sands Missile Range, with the 101st Airborne Division operating from Fort Campbell, Kentucky, serving as the division headquarters.

In contrast to NIE 12.2, NIE 12.1 focused on Wide Area Security missions executed predominately at the company level. Brigade and battalion tactical operations centers and company command posts operated from fixed sites and were dependent upon a fixed aerial tier of 100-foot towers and aerostats in order to establish network connectivity.

Threat Operations. The Army continues to improve threat operations during NIEs. NIE 12.2 was the first NIE in which threat information operations, such as electronic warfare and computer network operations, were fully integrated into the threat commander's scheme of maneuver. An aggressive, adaptive threat intent on winning the battle is an essential component of good operational testing. The Army should continue to ensure that future NIEs contain a robust threat force, to include threat information warfare capabilities.

Schedule-Driven Programs. The Army remains schedule-driven to meet NIE objectives, vice pursuing an event-driven schedule appropriate to acquisition system development.

In NIE 12.1 the Army proceeded to the Rifleman Radio IOT&E despite unfinished developmental testing. Developmental testing conducted prior to the IOT&E indicated that the Rifleman Radio was demonstrating reliability of roughly one-half its intended requirement (277 hours of Mean Time Between Essential Function Failure (MTBEFF) compared to a requirement of 477 hours). Predictably, Rifleman Radio's reliability demonstrated during the IOT&E fell far short of the requirement, demonstrating a 161-hour MTBEFF.

In NIE 12.2, the Army proceeded with the Manpack radio MOT&E despite developmental testing results indicating that the Manpack radio Single Channel Ground and Airborne Radio System (SINCGARS) waveform performance was not satisfactory and that the Manpack radio was falling short of its reliability requirements. The OSD's Deputy Assistant Secretary of Defense for Developmental Test and Evaluation in its Assessment of Operational Test Readiness (AOTR) identified these developmental testing deficiencies prior to the start of the MOT&E. The Manpack radio MOT&E results confirmed both the SINCGARS waveform deficiency and reliability shortfall previously identified in developmental testing. Furthermore, Manpack radio vehicle integration was poorly executed and not adequately tested prior to the MOT&E, resulting in poor vehicular-mounted radio performance in the MOT&E. The AOTR also identified insufficient developmental testing to assess vehicle integration prior to the MOT&E.

According to system development best practices, the Army should not proceed to IOT&E with a system until it has completed developmental testing and the program has corrected any identified problems. Otherwise, the Army runs the risk of conducting costly operational tests that only serve to confirm developmental testing conclusions about poor system performance, without affording the Program Office the opportunity to fix system shortfalls.

Too Many Systems. The Army continues to insert a large number of immature systems into NIEs. The 25 SUEs contained in the NIE 11.2 stressed the Army's evaluation capacity, indicating a need to reduce the number of SUEs in later NIEs. Nevertheless, NIE 12.1 contained 47 SUEs and NIE 12.2 included 36 SUEs. Too many immature systems in the NIE challenges the Army's capacity to employ appropriate instrumentation, collect relevant data, and conduct full and adequate assessments, detracting from the Army's capability to perform focused evaluations. Having this large number of SUEs in the NIE stresses the test unit's capacity to adequately train operators on the new systems. In addition, it strains the unit's ability to understand the systems' intended concepts of operations and to integrate the systems into unit operations. These limitations make it challenging to thoroughly examine the capabilities of each SUE. Finally, much of the NIEs' overall cost can be attributed to the inclusion of these SUEs. Whether the knowledge gained of the SUEs justifies the overall cost is unclear.

Logistics. NIEs are still not replicating realistic battlefield maintenance and logistical support operations for systems under test. Field Service Representative (FSR) support plans, maintenance and repair parts stockage, and the quantity and management of system spares, do not accurately reflect what a unit will observe upon fielding. For example, the JTRS HMS Manpack System Support Package provided by the Program Office for use in the MOT&E did not accurately reflect expected system support after fielding. The density of contract FSRs and spare radios far exceeded what is likely to be the case within fielded brigades. Easy access and over reliance on FSR support resulted in the test unit not having to realistically execute its field-level maintenance actions. Failure to accurately replicate "real world" maintenance and logistics support cause operational availability rates and ease of maintenance to be overestimated in NIEs.

AN/PRC-117G

Executive Summary

- The Army intends tactical units to employ the AN/PRC-117G as a data radio. The radio will be used as an interim commercial off-the-shelf (COTS) solution until the Multi-Tier Networking Vehicle Radio (MNVR) is developed and fielded. The MNVR is intended to replace the cancelled Joint Tactical Radio System Ground Mobile Radio (JTRS GMR) program.
- The AN/PRC-117G radio is not a Program of Record. As a result, there is no acquisition strategy, documented requirements, or Test and Evaluation Master Plan. The Army has used an existing General Services Administration contract to purchase the AN/PRC-117G.
- The Army Test and Evaluation Command conducted an operational assessment of the AN/PRC-117G from October through November 2011 at Fort Bliss, Texas, and White Sands Missile Range, New Mexico, in conjunction with the Army's Network Integration Evaluation (NIE) 12.1.
- The AN/PRC-117G performed satisfactorily in transmitting digital Position Location Information. However, full AN/PRC-117G capability was not exercised or evaluated. AN/PRC-117G demonstrated satisfactory reliability and interoperability with the Rifleman Radio and its corresponding Soldier Radio Waveform (SRW) network.

System

- The AN/PRC-117G radio is a single channel voice and data radio that is capable of operating in a frequency range of 30 Megahertz to 2 Gigahertz. It can be configured for manpack, vehicular-mounted, or base station operations. The primary AN/PRC-117G waveform is the Advanced Networking Wideband Waveform (ANW2), which is a Harris Corporation proprietary waveform. The AN/PRC-117G is capable of simultaneously transmitting both Voice over Internet Protocol (VoIP) and digital data on a single channel. Digital data include file transfers, chat, streaming video, and position location reports. ANW2 allows units to use internet protocol routing to transmit medium to high bandwidth data traffic over tactical Very High Frequency, Ultra High Frequency, and L-band radio networks.
- The AN/PRC-117G radio is not a Program of Record. As a result, there is no acquisition strategy, documented requirements, or Test and Evaluation Master Plan.

Mission

The Army intends for tactical units to employ the AN/PRC-117G as a data radio. AN/PRC-117G will be an interim COTS solution until the MNVR is developed and fielded. The MNVR is intended to replace the cancelled JTRS GMR program.

Major Contractor

Harris Corporation – Rochester, New York

Activity

- The Army is purchasing the AN/PRC-117G as a COTS item to fill a capability gap for a tactical digital radio. With the October 2011 cancellation of JTRS GMR, the Army sought an interim solution to fill Brigade Combat Teams as a part of Capability Set 13. The Army has used an existing General Services Administration contract to purchase the AN/PRC-117G.
- The Army Test and Evaluation Command conducted an operational assessment of the AN/PRC-117G from October through November 2011 at Fort Bliss, Texas, and White Sands Missile Range, New Mexico, in conjunction with the Army's NIE 12.1. During this event, a cavalry squadron equipped with Mine Resistant Ambush Protected vehicles executed typical cavalry missions in an Afghanistan-like scenario. A total of 26 AN/PRC-117Gs were used. These radios ran both the ANW2 and SRW.
- DOT&E has placed the AN/PRC-117G on oversight.

Assessment

- During the NIE event, the AN/PRC-117G performed satisfactorily in transmitting digital data. However, full AN/PRC-117G capability was not exercised or evaluated. The test unit only employed the AN/PRC-117G to transmit limited types of digital Joint Variable Message Format (JVMF) messages. The vast majority of the digital traffic was automated position location reports, with a small number of other JVMF messages pertaining to mortar fire missions. The unit did not employ the radio's voice capability, except in the case of the Rifleman Radio-equipped platoon. The AN/PRC-117G's capabilities for file transfer, transmitting streaming video, and chat were not employed in NIE 12.1, as the Army did not give the test unit the capability or opportunity to do so.

- The SRW successfully ran on several AN/PRC-117Gs, which allowed the Rifleman Radio-equipped platoon to transmit to the AN/PRC-117G the position location reports generated by Rifleman Radio-equipped Soldiers. From the AN/PRC-117G, these position locations crossed over to the ANW2 in the platoon leader's vehicle, enabling these position locations to be displayed at the troop and squadron level. This troop also successfully used the AN/PRC-117G running SRW for VoIP with Rifleman Radio-equipped platoon members.
- The AN/PRC-117G demonstrated a point estimate Mean Time Between Essential Function Failure (MTBEFF) of 511 hours, which exceeds the JTRS GMR single channel requirement of 477 hours MTBEFF. This result is over five times greater than the JTRS GMR reliability demonstrated in NIE 11.2.

Recommendations

- Status of Previous Recommendations. This is the first annual report for this program.
- FY12 Recommendation.
  1. The Army should conduct sufficient government developmental and operational testing to fully characterize system performance. A future operational assessment should be executed in which the test unit employs the system to its full capability, including streaming video, file transfers, chat, and VoIP.

Apache Block III (AB3) Upgrade

Executive Summary

- The Army conducted the Apache Block III (AB3) IOT&E at the National Training Center in Fort Irwin, California, March through April 2012. The test included training, force-on-force missions, live fire of all weapon systems, and threat penetration testing of AB3 computer networks. The IOT&E was preceded by four years of developmental testing that included analysis, modeling and simulation, component qualification testing, testing in extreme environments, system-level flight testing, weapons qualifications, and live fire testing.
- The Army completed LFT&E of AB3 flight critical and force protection components followed by vulnerability analyses to evaluate aircraft ballistic survivability.
- In August 2012, DOT&E submitted a Combined Initial Operational Test and Evaluation and Live Fire Test and Evaluation report to Congress evaluating:
  - AB3 as operationally effective. It has improved flight performance compared to legacy Apache Block II (AB2) aircraft. When aided by real-time unmanned aircraft system (UAS) video containing actionable intelligence, AB3 teams demonstrated target acquisition ranges, Hellfire missile engagement ranges, and mission success rates greater than the legacy AB2 aircraft.
  - AB3 as operationally suitable. The aircraft exceeded reliability thresholds with statistical confidence and met all current maintainability requirements. Overall, flight safety is enhanced by the aircraft's ability to operate with increased power margins.
  - AB3 as at least as survivable as legacy AB2 aircraft. New AB3 subsystems met survivability requirements and demonstrated ballistic tolerance similar to legacy AB2 aircraft.

System

- The AB3 is a modernized version of the AH-64D Attack Helicopter with which the Army intends to sustain the Apache fleet through the year 2040. The Army intends to organize the AB3 in Attack/Reconnaissance Battalions assigned to the Combat Aviation Brigades. Each Battalion will have 24 aircraft.
- The Army acquisition objective is to procure 690 AB3 aircraft: 634 remanufactured and 56 new build aircraft. Remanufactured and new build AB3 aircraft are built on the same assembly line in Mesa, Arizona, and are essentially the same aircraft.
- The AB3 aircraft capability improvements include:
  - Levels 2 through 4 UAS control by the AB3 aircrew
    - Level 2 receives and displays UAS data/video feed
    - Level 3 receives and displays UAS data/video feed and enables the aircrew to control the UAS payload (sensor)
    - Level 4 receives and displays UAS data/video feed and enables the aircrew to control the flight path of the UAS and the payload
  - Improved Radar Electronic Unit to provide radio frequency interferometer passive ranging, extended fire control radar range, and maritime targeting capability
  - Improved aircraft performance with 701D engines, composite main rotor blades, weight reduction through processor and avionic upgrades, and an improved rotor drive system
  - Enhanced survivability with integrated aircraft survivability equipment and additional crew and avionic armoring
  - Enhanced communication capability, which includes satellite communication, Link 16 datalink, and an integrated communication suite to meet global air traffic management requirements
  - Improved reliability and maintainability using embedded system-level diagnostics, improved electronic technical manuals, and reduced obsolescence

Mission

The Attack/Reconnaissance Battalions assigned to the Combat Aviation Brigade will employ the AB3 to conduct the following types of missions:

- Attack
- Movement to contact
- Reconnaissance
- Security

Major Contractors

- Aircraft: The Boeing Company Integrated Defense Systems – Mesa, Arizona
- Sensors and UAS datalink: Longbow Limited – Orlando, Florida, and Baltimore, Maryland

Activity

- The Army conducted the AB3 IOT&E in accordance with the DOT&E-approved test plan from March 16, 2012, through April 13, 2012, at the National Training Center in Fort Irwin, California. The IOT&E consisted of force-on-force missions with a dedicated opposing force; live fire of all weapon systems; and threat penetration testing of AB3 computer networks.
- Prior to the IOT&E, the test unit completed three weeks of classroom, simulator, and flight training at the Boeing facility in Mesa, Arizona. Legacy AB2 aircraft and aircrews conducted home-station training prior to deploying to the National Training Center.
- During IOT&E, five AB3 aircraft flew 367 flight hours. The five AB3 aircraft and five legacy AB2 aircraft conducted 28 force-on-force missions under varying conditions. The conditions were selected using Design of Experiments methodology with four factors: aircraft type (AB3 or AB2), mission type (reconnaissance or attack), UAS support (with or without), and light level (day or night). A single Gray Eagle UAS with associated flight crew and personnel provided mission support to the IOT&E from Edwards AFB, California.
- The Army conducted ballistic testing of production-representative AB3-improved drive system components and composite main rotor blades (CMRBs) from May through July 2011 at Aberdeen Proving Ground, Maryland.
- The Army conducted ballistic shots against 20 crew armor panels on December 7, 2010, to verify performance against the key performance parameter force protection threat.
- At the conclusion of ballistic testing, the Army completed a system-level vulnerability analysis using a modeling and simulation suite that models target-threat interaction for direct fire and small projectiles on air and ground systems.
- The Air Force approved the Mission Design Series request to designate the AB3 as the AH-64E on September 6, 2012.
- In August 2012, DOT&E submitted a Combined Initial Operational Test and Evaluation and Live Fire Test and Evaluation report to Congress.
- The USD(AT&L) conducted a Defense Acquisition Board on August 16, 2012. The key decisions include the following.
  - Approve full-rate production for the Apache Block IIIA (AB3A) Remanufacture program.
  - Authorize the procurement of up to 12 low-rate initial production aircraft in FY13 for the Apache Block IIIB (AB3B) New Build program.
  - The Army will fully fund the AB3A Remanufacture program to the Director of Cost Assessment and Program Evaluation-approved independent cost estimate.
  - Upon approval of the AB3A Remanufacture Acquisition Program Baseline, the AB3A Remanufacture and AB3B New Build programs will be designated as Acquisition Category 1C programs.

Assessment

- The AB3 is operationally effective. It has improved flight performance compared to legacy AB2 aircraft, and when aided by real-time UAS video containing actionable intelligence, AB3 teams demonstrated target acquisition ranges, Hellfire engagement ranges, and greater mission success rates than legacy AB2 aircraft teams.
- AB3 crews were consistently able to establish a datalink with Gray Eagle to receive UAS video. Crews had some difficulty establishing and maintaining control of the Gray Eagle sensor.
- There is a pilot confidence concern with the AB3 transmission design. It has a single tail rotor output pinion that provides power for the tail rotor, hydraulic pump, and electric generator. A failure of this one pinion could be catastrophic for the aircrew, as this would result in the simultaneous loss of the tail rotor, electric generator, and hydraulic power.
- AB3 is operationally suitable. The helicopter exceeded its reliability thresholds with statistical confidence and met all current maintainability requirements. The redesigned AB3 helmet offers improved comfort and performance compared to the legacy helmet. Overall, flight safety is enhanced by AB3's increased power margins relative to legacy AB2 aircraft.
- The AB3 is at least as survivable as the legacy AB2 aircraft. New AB3 subsystems met survivability requirements and demonstrated ballistic tolerance similar to legacy AB2 aircraft.
- Infrared countermeasures provide protection against most man-portable rocket system threats, but the Army should improve the laser and radar warning systems. Consistent with other DOT&E evaluations, the APR-39A(V)4 radar warning receiver was not effective during IOT&E. Radar warning receiver false alarms were so pervasive during the IOT&E that the pilots ignored or turned off all countermeasure warning systems.
- The AB3 is vulnerable to computer network attack. An Army threat computer network operations team conducted limited penetration testing of AB3 computer networks. The threat team considered three attack vectors to gain access to the AB3 networked systems: the Blue Force Tracker, the Aviation Mission Planning System, and aircraft maintenance ports. Threat team activities were limited to computer network scanning (passive and active) while the AB3 aircraft were on the ground, so as not to affect flight operations. The team was successful in gaining access to AB3 systems.
- The CMRB has very low vulnerability to most small arms threats. However, during another test, a larger threat impacted the blade spar and removed a substantial portion of the spar's cross-sectional area. The blade completed 30 minutes of operation, despite a loss of structural stiffness. While spinning, the centrifugal forces kept the blade straight, but as the blade rotation slowed after the shot, the blade folded downward at the damage location. It is uncertain if the observed damage would have resulted in catastrophic blade failure within 30 minutes under actual flight conditions, or if

equivalent damage located at another spar location would have resulted in the same outcome.

Recommendations

- Status of Previous Recommendations. The Army continues to address all DOT&E recommendations from previous testing. Many of the recommendations, including the Fire Control Radar performance anomalies and the AB3 aviator helmet fit and visibility display, were addressed and changed prior to the IOT&E.
- FY12 Recommendations. The Army should:
  1. Continue to refine tactics, techniques, and procedures for teaming with UASs. Determine the root cause for datalink dropouts and improve the stability of the tactical command datalink for control of UAS sensors.
  2. Consider incorporating improvements to current threat warning systems as they are developed. Upgrade radar and laser warning systems and provide for adjustable controls for each warning system.
  3. Address pilot's confidence concerns with regard to the transmission design. Conduct physics of failure analysis to provide an independent analysis of the probability of failure of the new tail rotor pinion design. Investigate the feasibility of alternate transmission designs that provide automatic redundant hydraulic and electrical power in the event of loss of power to the tail rotor.
  4. Address the Information Assurance vulnerabilities identified.
  5. Perform a structural analysis of the CMRB to better understand the load carrying capabilities of the blade that was damaged during ballistic testing.

Armored Tactical Vehicles – Army

FMTV
(Family of Medium Tactical Vehicles)

HMMWV
(High Mobility Multi-purpose Wheeled Vehicle)

HET
(Heavy Equipment Transporter)

Executive Summary

- DOT&E delivered the Family of Medium Tactical Vehicles (FMTV) LFT&E Report to Congress in October 2011.
- DOT&E provided an Operational Assessment to support the re-procurement decision of the Oshkosh FMTV. A transportation unit can accomplish line and local haul convoy missions using the Oshkosh FMTV in the same manner as the fielded FMTV.
- The Army is developing a Modernized Expanded Capacity Vehicle (MECV) High Mobility Multi-purpose Wheeled Vehicle (HMMWV) survivability test series to determine available enhanced protection capabilities. In a parallel effort, the Marine Corps is exploring a HMMWV sustainment modification initiative to restore lost reliability and mobility capabilities due to armoring vehicles.
- Emerging Heavy Equipment Transporter (HET) underbody test results indicate that the HET Underbody Improvement Kit (UIK) increases crew protection against under-vehicle threats.

System

FMTV

- The FMTV re-procurement is the fourth stage of FMTV progression. These vehicles consist of the following light and medium variants intended to operate on- and off-road:
  - The Light Medium Tactical Vehicle (LMTV) transports a 5,000-pound payload and a 12,000-pound towed load.
  - The Medium Tactical Vehicle (MTV) transports a 10,000-pound payload and a 21,000-pound towed load.

HMMWV

- The HMMWV is a general purpose tactical wheeled vehicle with light and heavy variants.
  - The Light Variant includes the light utility, weapon carrier, and ambulance with a required minimum payload of 2,600 pounds.
  - The Heavy Variant includes the heavy shelter carrier, light and heavy howitzer towing variant, and ambulance with a required minimum payload of 4,550 pounds.
- The MECV HMMWV effort is intended to identify improved underbody crew protection, scalable armor, and the ability to regain automotive performance.

HET

- The M1070 HET is an eight-wheeled tractor used to transport the M1 main battle tank and other large equipment weighing up to 70 tons to and from the battlefield.
- The HET UIK is designed to provide improved underbody blast protection to the fielded HETs. The vehicle seats were modified in conjunction with the UIK development.

Mission

FMTV

- The Army employs the FMTV to provide multi-purpose transportation and unit mobility vehicles in maneuver, maneuver support, and sustainment units.

HMMWV

- The HMMWV provides highly mobile light tactical wheeled transport for command and control, troops and light cargo, medical evacuation, and weapon platforms to division and below units. This vehicle is employed throughout the battlefield and operates in off-road and cross-country environments.

HET

- The M1070 HET is used to transport, deploy, recover, and evacuate combat-loaded tanks and other large tracked and wheeled vehicles.

Major Contractors

FMTV & HET

- Oshkosh Corporation – Oshkosh, Wisconsin

HMMWV

- AM General – South Bend, Indiana

Activity

FMTV

- The Army completed the Production Verification Testing (PVT) of the Oshkosh FMTV Wrecker at Aberdeen Proving Ground, Maryland. The purpose of the PVT was to ensure that performance, reliability, and maintainability met the requirements for the vehicle.
- The Army Test and Evaluation Command completed the FMTV Developmental/Operational Test (DT/OT) at Aberdeen Proving Ground in June 2011 in accordance with the DOT&E-approved test plan.
- DOT&E delivered the FMTV LFT&E Report to Congress in October 2011.
- DOT&E provided an Operational Assessment in October 2011 to support the re-procurement decision of the FMTV by Oshkosh.

HMMWV

- In February 2012, the Army Test and Evaluation Command (ATEC) completed developmental testing and a user evaluation of the M997A3 HMMWV Ambulance at Aberdeen Proving Ground, Maryland, to support the procurement of 500 vehicles for the Army National Guard.
- The Army is developing an MECV HMMWV survivability test series to determine available enhanced protection capabilities. In a parallel effort, the Marine Corps is exploring a HMMWV sustainment modification initiative to restore lost reliability and mobility capabilities due to armoring vehicles.

HET

- ATEC conducted four system-level underbody blast tests against the HET UIK at the Aberdeen Test Center, Aberdeen, Maryland. The results compare the blast protection of the base and up-armored HET.
- The M1070 HET Live Fire test series included threats above Mine Resistant Ambush Protected All-Terrain Vehicle levels.
- The program procured 55 HET UIKs in August 2011.

Assessment

FMTV

- Based on DT/OT results, a transportation unit can accomplish line and local haul convoy missions using the Oshkosh FMTV in the same manner as the fielded FMTV.
- During PVT, the Oshkosh FMTV Wrecker demonstrated 8,000 Mean Miles Between Hardware Mission Failure (MMBHMF) versus its operational requirement of 5,000 MMBHMF. The Wrecker is capable of recovering and towing wheeled vehicles such as the HMMWV, 5-ton truck series, and FMTV vehicles over a variety of terrain and surfaces.

HMMWV

- Contractor results from the ballistic tests on the potential MECV designs demonstrated that improvements in survivability are feasible. The Army will retest these designs during the MECV HMMWV survivability test series.
- The M997A3 HMMWV Ambulance contributes to the accomplishment of the medical ground evacuation mission in support of Homeland Defense and Homeland Security operations based on the results of developmental testing and user evaluation. The medical crews effectively collected, provided en-route treatment, and transferred patients from simulated points of injury to a treatment facility utilizing the Ambulance. The M997A3 HMMWV Ambulance demonstrated a Mean Miles Between Operational Mission Failure of 3,053 miles during DT/OT versus the 1,637 miles requirement.

HET

- Emerging underbody test results indicate that the M1070 HET UIK increases crew protection against under-vehicle strikes.

Recommendations

- Status of Previous Recommendations. The Army addressed all previous recommendations.
- FY12 Recommendations. None.

Bradley Engineering Change Proposal (ECP)

Executive Summary

- The Bradley Engineering Change Proposal (ECP) LFT&E was initiated to evaluate the vulnerability of ECP upgrades, which intend to restore ground clearance and integrate new network technologies and to evaluate the vulnerability of urgently fielded survivability kits, which are now part of the M2A3 configuration.
- In September 2012, the Army conducted two underbody blast tests on the M2A3 Infantry Fighting Vehicle with ECP1 components that revealed severe vehicle and occupant vulnerabilities. These two tests are not sufficient to address all of the critical survivability concerns with the Bradley Fighting Vehicle Systems (BFVS). Additional testing is required.

System

- The Bradley ECP1 intends to restore ground clearance with upgrades to the suspension and track and ECP2 intends to integrate network technologies as they become available for the following three variants of the BFVS:
  - M2A3 Infantry Fighting Vehicle
  - M3A3 Cavalry Fighting Vehicle
  - Bradley Fire Support Team with Fire Support Sensor System
- The Bradley Urban Survivability Kit I, II, and III and add-on-armor kit intend to improve vehicle and crew survivability. These kits were urgently fielded for Operation Iraqi Freedom and are now part of the M2A3 configuration.

Mission

Combatant Commanders employ BFVS-equipped Armor Brigade Combat Teams to provide protected transport of Soldiers; provide overwatching fires to support dismounted infantry and suppress an enemy; and perform missions to disrupt or destroy enemy military forces and control land areas.

Major Contractor

BAE Systems Land and Armaments – Sterling Heights, Michigan

Activity

- The Army initiated the Bradley Engineering Change Proposal (ECP) LFT&E to evaluate the vulnerability of ECP upgrades, which include an upgraded suspension, upgraded track, and new network technologies and to evaluate the vulnerability of urgently fielded survivability kits, now part of the M2A3 configuration.
- DOT&E approved the Phase 1 Bradley ECP LFT&E strategy in August 2012.
- In September 2012, the Army conducted two underbody blast tests at the Aberdeen Test Center on the M2A3 Infantry Fighting Vehicle with ECP1 components to characterize the system's vulnerability.
- The Program Office wrote a draft Test and Evaluation Master Plan (TEMP) that outlined the Bradley ECP1 operational and live fire test plans, test methods, resources, and evaluation plans. The draft TEMP is in staffing for review and approval. The Program Office will update the TEMP in 1QFY15 for ECP2.

Assessment

- Results from the first two underbody blast tests with realistic threats (as opposed to the outdated underbody requirement) conducted in September 2012 revealed severe vehicle and occupant vulnerabilities, which the Army plans to examine for possible improvement. The first two underbody tests are not sufficient to address all of the critical BFVS survivability concerns.
- Results from the first two underbody blast tests also demonstrate that survivability modifications to the Bradley Fighting Vehicle would be required if it is chosen as the platform for the Armored Multi-purpose Vehicle (AMPV) to meet the draft AMPV survivability requirement.

Recommendations

- Status of Previous Recommendations. This is the first annual report for this program.

- FY12 Recommendations.
  1. The Army must provide a comprehensive live fire strategy for DOT&E approval, which includes plans for additional tests required to comprehensively evaluate the force protection and survivability provided by the Bradley Urban Survivability Kit I, II, and III; add-on-armor kit; ECP1; and ECP2 components.
  2. The Army should correct the vulnerabilities identified during underbody blast testing prior to using the vehicles in combat situations in which underbody threats are prevalent.

Common Remotely Operated Weapon Station (CROWS)

Executive Summary

- The Army conducted an Initial Operational Test (IOT) in 2009.
- Early in FY12, the Army Acquisition Executive notified the USD(AT&L) that the CROWS program was expected to become a Major Defense Acquisition Program with the Army as the lead Service. This designation caused the program to come under DOT&E oversight.
- In June 2012, Program Executive Office (PEO) Soldier requested that DOT&E prepare an OT&E report to Congress to support a September 2012 production decision for the procurement of the final 1,212 CROWS systems.
- In September 2012, DOT&E provided Congress with an assessment of the operational effectiveness and operational suitability of the CROWS mounted on Up-Armored High Mobility Multi-purpose Wheeled Vehicles (UAHs) based upon the results of the IOT, developmental testing, and CROWS New Equipment Training (NET) at Fort Campbell, Kentucky.
- The CROWS system is operationally effective. The CROWS target acquisition and engagement capabilities enable units to detect and engage targets at long range while both on-the-move and stationary relative to non-CROWS equipped units. CROWS operators are provided protection over Objective Gunner Protection Kit (OGPK) gunners because of the CROWS ability to fire remotely. Nonetheless, CROWS has some limitations in comparison with the OGPK due in part to the limited fields of view of the CROWS daytime and nighttime sensors.
- The CROWS system is operationally suitable. During IOT, the CROWS exceeded its reliability requirement. The CROWS-equipped UAH demonstrated the capability to perform its mission essential functions of move, shoot, and communicate.

System

- CROWS is a gunner-operated system that provides the capability to remotely aim and fire the MK19 Grenade Machine Gun (GMG), M2 Machine Gun, M240 Machine Gun, or the M249 Machine Gun from a stationary platform or while on-the-move.
- The M153 CROWS consists of weapons cradles, traverse and elevation drives, weapon interface, weapon remote charger, ammunition container and feed system, laser range finder, day/night viewing and sighting unit, joystick, and remote fire control and display unit.

Mission

Gunners within a vehicle crew or in a stationary battle position use CROWS to improve their weapon's performance through enhanced target acquisition, identification, and engagement capabilities while firing remotely. Units equipped with CROWS include Infantry, Artillery, Armor, Cavalry, Engineer, Chemical, and Military Police.

Major Contractor

Kongsberg Defense Corporation – Johnstown, Pennsylvania

Activity

- The Army conducted an IOT in 2009. At the time the IOT was conducted, CROWS was an Acquisition Category (ACAT) II program and was not on DOT&E oversight. The Army Test and Evaluation Command (ATEC) was responsible for approving the test plan, conducting the IOT, and reporting its evaluation to the Army.
- ATEC conducted the IOT at Fort Carson, Colorado, from October – November 2009. For the IOT, the performance of a CROWS-equipped Military Police (MP) unit was compared to an MP platoon equipped with OGPKs. All four types of weapons were used during the test. Representatives from DOT&E visited the site during the conduct of the IOT in 2009 to monitor test execution adequacy.
- Early in FY12, the Army Acquisition Executive notified USD(AT&L) that the CROWS program was expected to reach an ACAT I funding level for the procurement year. In March 2012, the USD(AT&L) designated the CROWS

program as an ACAT IC Major Defense Acquisition Program with the Army as the lead Service.
- In June 2012, PEO Soldier requested that DOT&E prepare an OT&E report to Congress to support a September 2012 production decision for the procurement of the final 1,212 CROWS systems.
- In August 2012, DOT&E observed the revised CROWS NET at Fort Campbell, Kentucky. Thirty-two Soldiers from different units at Fort Campbell participated.
- In September 2012, DOT&E provided Congress with an assessment of the operational effectiveness and operational suitability of the CROWS mounted on UAHs based upon the results of the IOT, developmental testing, and the revised CROWS NET.

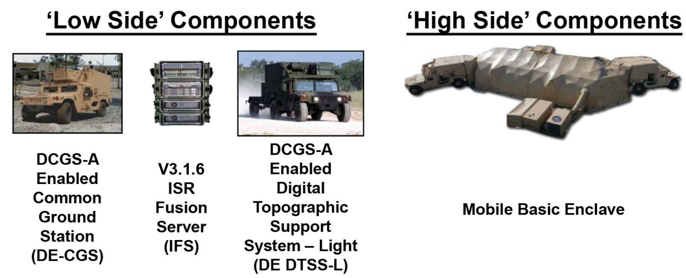
Assessment
- Representatives from DOT&E monitored the Army's IOT at Fort Carson, Colorado, in 2009 and assessed that it was adequately executed.
- The CROWS system is operationally effective. The CROWS target acquisition and engagement capabilities enable units to detect and engage targets at long range while both on-the-move and stationary relative to non-CROWS equipped units.
  - The CROWS provides enhanced lethality and is more accurate while firing on-the-move at long ranges than a crew-served weapon fired by a gunner using the OGPK.
  - CROWS operators are provided protection over OGPK gunners because of the ability to remotely fire CROWS. A unit with CROWS-equipped vehicles can synchronize target acquisition, maneuver, and provide responsive fires during missions such as Convoy Security, Route Reconnaissance, and Overwatch.
- The shortcomings of CROWS identified during IOT were that the operator and crew struggled to detect enemy personnel close to the vehicle and to maintain situational awareness of their surroundings. Additionally, they were slower than the OGPK-equipped UAHs in determining the location of enemy fire as the CROWS operator and crew lacked the visual and auditory cues necessary to stay in the firefight.
- The CROWS daylight sight provides a 47-degree field of view and its minimum focus distance is 2 meters. The CROWS thermal sighting only provides a narrow 10-degree field of view. These capabilities limit the gunner/operator from rapidly acquiring dispersed targets, whereas a gunner operating the OGPK can rapidly scan for and detect close-in and widely dispersed targets.
- The CROWS system is operationally suitable. During IOT, the CROWS exceeded its reliability requirement. The CROWS-equipped UAH demonstrated the capability to perform its mission essential functions of move, shoot, and communicate.
- The revised 2012 NET is improved over that conducted in 2009. The new program of instruction (POI) incorporates expanded hands-on, situational awareness, safety, and gunnery live-fire exercises. The POI now includes lessons on the correct method to establish no-fire and no-traverse zone.

Recommendations
- Status of Previous Recommendations. This is the first annual report for this program.
- FY12 Recommendations. The CROWS program manager should:
  1. Conduct follow-on operational testing to evaluate the effectiveness and suitability of CROWS as it is integrated for use on combat vehicles in addition to the High Mobility Multi-purpose Wheeled Vehicle and Mine Resistant Ambush Protected vehicle.
  2. Investigate increasing the field of view of the CROWS daytime and thermal sights to improve CROW operator determination of enemy location. The CROWS imaging sights have limited field of view, which affects the crew's ability to acquire and engage the enemy.
  3. Test to confirm the updated fire tables corrective action improve the MK19 accuracy with CROWS in a desert environment.
  4. Validate that link guide corrective action deflects expended cartridge cases and links.

Distributed Common Ground System – Army (DCGS-A)

Executive Summary

- The Army Test and Evaluation Command (ATEC) conducted a Developmental Test/Early User Test (DT/EUT) on the Distributed Common Ground System – Army (DCGS-A) Software Baseline 1.0 (DSB 1.0) from August through September 2011, to provide information for the Milestone C decision in February 2012.
- DOT&E published a DCGS-A DSB 1.0 Operational Assessment Report in January 2012. ATEC conducted the test in a non-operationally representative laboratory environment. Based on the DT/EUT data, DOT&E evaluated DSB 1.0 to be sufficiently mature to enter production in preparation for IOT&E, but recommended improvements to Tactics, Techniques, and Procedures (TTPs); individual and collective training; and system reliability.
- ATEC conducted the DSB 1.0 IOT&E from May through June 2012, utilizing an operationally representative field configuration.
- DOT&E published a DCGS-A DSB 1.0 IOT&E Report in October 2012 that evaluated DSB 1.0 to be not operationally effective, not operationally suitable, and not survivable based on the IOT&E data.
  - During IOT&E, the physical configuration of DSB 1.0 forced unnecessary foot traffic and data exchange through the security cross-domain guard since most of the data needed for the fusion is Secret, but the fusion capability was only in the Sensitive Compartmented Information (SCI) enclave. Physical barriers and security procedures between the SCI enclave and the remainder of the DSB 1.0 system inhibited exchange and fusion of data to the point where DOT&E assessed the DSB 1.0 system to be not operationally effective.
  - Additionally, software faults within the SCI enclave were a primary factor in the evaluation of the DSB 1.0 system as not operationally suitable.
- The Army reconfigured DSB 1.0 without the SCI enclave to mitigate the effectiveness and suitability shortfalls identified in the IOT&E report and demonstrated fixes to the critical Information Assurance (IA) shortfalls that led to the evaluation that the system was not survivable. The reconfigured package is called Release 1.
- DOT&E released a memorandum in November 2012 that stated Release 1 will provide users with capabilities at least as good as those provided by the current systems.



System

- DSB 1.0 establishes the architecture that will provide an organic net-centric Intelligence, Surveillance, and Reconnaissance (ISR) capability. DSB 1.0 integrates three major existing systems and provides new SCI components to brigade combat teams. The major components include the following:
  - V3.1.6 ISR Fusion Server is the same as the currently fielded DCGS-A v3.1.6 and organizes and processes raw intelligence reports into coherent information at the Secret classification level.
  - DCGS-A Enabled Common Ground Station provides multisensory imagery intelligence data processing and evaluation capability.
  - DCGS-A Enabled Digital Topographic Support System – Light provides geospatial analysis and production capability.
  - Mobile Basic Enclave contains new components designed to provide signal intelligence capability and intelligence fusion and analysis capability for Top Secret information and SCI.
- DCGS-A allows users to collect, process, fuse, and display intelligence on six types of enemy entities: individuals, units, equipment, facilities, events, and organizations.
- DCGS-A is the information- and intelligence-processing centerpiece of the Army ISR framework and is the enabler for all intelligence functions at the Division, Brigade Combat Team, Maneuver Battalion, and Company levels.

Mission

Army intelligence analysts use DSB 1.0 to support six Mission Command Capabilities:

- Display and share relevant information
- Provide a standard and shareable geospatial foundation
- Collaborate in voice, text, data, and video modes
- Execute running estimates of enemy force progress
- Provide mission rehearsal and training support
- Interoperate across the joint, interagency, intergovernmental, and multinational forces

Major Contractor

Northrop Grumman Electronic Systems – Linthicum, Maryland

Activity

- From August through September 2011, ATEC conducted the DT/EUT utilizing a non-operationally representative system configuration at the Intelligence Systems Integration Laboratory at Fort Huachuca, Arizona. In the laboratory configuration, the SCI enclave and the rest of the DSB 1.0 system were connected by a single secured door. Testing was conducted in accordance with a DOT&E-approved test plan.
- DOT&E published the DCGS-A DSB 1.0 Operational Assessment Report in January 2012 informing the Milestone Decision Authority on the test results of the DT/EUT.
- The Milestone Decision Authority signed the Acquisition Decision Memorandum in March 2012, approving limited deployment for IOT&E.
- From May through June 2012, ATEC conducted the IOT&E at Fort Stewart, Georgia, with the 4th Brigade Combat Team, 3rd Infantry Division operating the system in an operationally representative field configuration. In the fielded configuration, the SCI enclave and the rest of the DSB 1.0 system were separated physically and by security barriers (concertina wires and guarded entrances). Testing was conducted in accordance with a DOT&E-approved test plan.
- In October 2012, DOT&E provided an IOT&E report to the Milestone Decision Authority and Congress.
- The Army reconfigured the DSB 1.0 without the SCI enclave to mitigate the effectiveness and suitability shortfalls identified in the IOT&E report, and demonstrated fixes to the critical IA shortfalls. The reconfigured package is called Release 1.
- DOT&E released a memorandum in November 2012 that stated Release 1 will provide users with capabilities at least as good as those provided by the current systems.

Assessment

- The DT/EUT demonstrated that the DSB 1.0 system had shortfalls but was sufficiently mature to enter production in preparation for IOT&E.
  - During the DT/EUT, test data showed operators using DSB 1.0 could execute all key missions, although software limitations forced the users to manually fuse data on two of the six entity types. DSB 1.0 could perform fusion for unit, equipment, facility, and event entities, but not for individuals and organizations. The software modules to fuse data on each entity type are unique due to the different data sets associated with each entity.
  - DSB 1.0 was not reliable due to software problems. The Mean Time Between Essential Capability Failure (MTBECF) of 3.8 hours fell short of the 160-hour requirement. The primary cause for all reliability failures was software (44 of 49 for all failures, 15 of 16 for essential capability failures).
  - The TTPs and training were not mature and needed improvement prior to IOT&E. The TTP and training shortfalls during DT/EUT precluded comprehensive operational evaluation of the end-to-end mission sequence. These shortfalls channelized testers' attention and precluded identification of the non-trivial problems (discovered later during IOT&E) that were associated with the physical separation of the SCI enclave and the rest of the DSB 1.0 system.
  - The Army did not evaluate DSB 1.0 survivability against cyber threats during DT/EUT.
- The change from a laboratory configuration to the fully fielded configuration in IOT&E significantly altered the test results from those seen during DT/EUT. The IOT&E results showed DSB 1.0 is not operationally effective, not operationally suitable, and not survivable.
  - The system is not effective because it inhibits effective workflows for the development of intelligence products to support operations. The system configuration, as tested, placed the intelligence fusion capability in the SCI (high) enclave even though most of the data to be fused are contained in the Secret (low) side. Additionally, collection management tools reside in the high side, but collection managers need to work closely with the brigade operations staff on the low side. Human intelligence tools are split between the high side and low side, but human intelligence analysts manage and interview their sources on the low side. The need for constant collaboration between high and low side personnel and the utilization of fusion capabilities contained only on the high side, in addition to physical separation and security procedures, inhibited access to capabilities and ultimately severely degraded the ability to generate a single, fused intelligence plot.
  - The system is not suitable because operators performing key mission tasks are interrupted with server reboots or reliability failures, on average, every 8 hours, and operators frequently need to recreate lost work as a result of computer resets. Training for the targeting and signal intelligence analysts using the new capabilities is inadequate.
  - The system is not survivable against cyber threats and does not provide adequate protection and detection against them.
- As reconfigured, Release 1 provides useful capability for the Army users, but does not fully satisfy the Key Performance Parameters (KPPs) for DSB 1.0.
  - Release 1 does not fully meet the Net-Ready KPP since the information exchange requirement that involves the SCI component is not satisfied.
  - Release 1 does not fully meet the Fusion KPP since the software that performs semi-automated fusion was hosted on the SCI enclave. However, Army users can perform fusion with manual assist.
  - Release 1 critical IA shortfalls have been corrected.

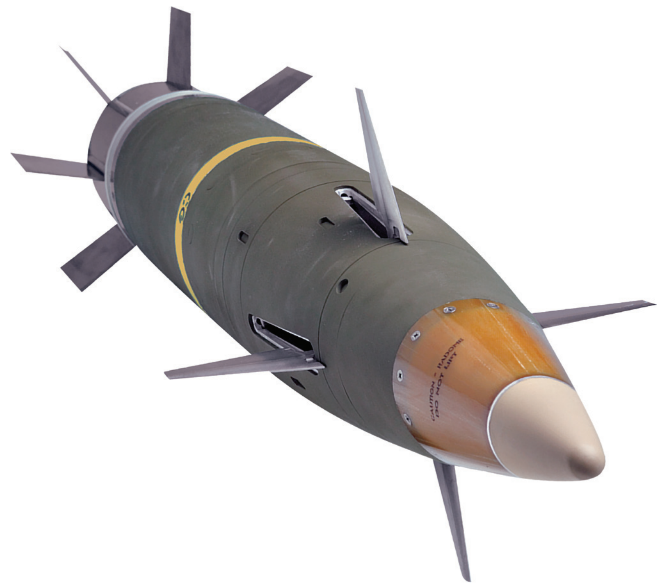
Recommendations

- Status of Previous Recommendations. This is the first annual report for this program.
- FY12 Recommendation.
  1. The Army should conduct operational testing of all releases of DCGS-A Increment 1 to be deployed for operational use.

Excalibur XM92 Precision Engagement Projectiles

Executive Summary
- As of July 2012, the Army has fired 601 Excalibur Ia projectiles in operational theaters with the Program Office reporting 90 percent reliability.
- In February 2012, technical challenges with the Increment Ib projectiles caused reliability concerns with the base assembly. This resulted in the program changing the configuration of the Increment Ib projectiles.
- Excalibur Increment Ib is scheduled for a December 2012 Milestone C decision.

System
- Excalibur is a family of precision-guided, extended-range, 155-millimeter artillery projectiles. The projectiles are fin-stabilized and glide to their target.
- The Army plans to develop three Excalibur variants:
  - High-Explosive, Unitary (Block I)
  - Smart (Block II)
  - Discriminating (Block III)
- All variants use GPS and an Inertial Measurement Unit (IMU) to attack point targets with accuracy of less than 10 meters from the desired aim point (in an unjammed environment).
- The Army is developing the High-Explosive, Unitary (Block I) projectile in three spirals of increasing capability (Ia-1, Ia-2, and Ib). The Ia-1 projectiles use aerodynamic lift generated by canards to extend range out to 24 kilometers without the maximum propellant charge. The Ia-2 and Ib projectiles add base bleed technology and use of the maximum propellant charge to further increase range to beyond 35 kilometers. The Army intends for the Increment Ib projectiles to improve reliability and reduce cost.



Mission
- Field Artillery units use Excalibur to attack enemy targets in support of maneuver operations at a greater range and with increased accuracy than standard high-explosive munitions.
- Field Artillery units use Excalibur to support the close fight in urban and complex environments, striking critical targets that must be engaged at extended ranges or in areas where minimal collateral damage is desired.

Major Contractor
Raytheon Missile Systems – Tucson, Arizona

Activity

Increment Ia
- Units in Operation Enduring Freedom (OEF) have been using Excalibur Increments Ia-1 and Ia-2 since February 2008. As of July 2012, Field Artillery units have fired 601 Excalibur projectiles in either Operation Iraqi Freedom or OEF.

Increment Ib
- In February 2012, technical challenges with the Increment Ib projectiles caused reliability concerns with the base assembly. This resulted in the program changing the configuration of the Increment Ib projectiles, reverting to the Ia spinning base assembly and warhead design.
- In June 2012, the contractor fired six Increment Ib projectiles in the contractor Gun Hardening P2 (GH P2) test at Yuma Test Center (YTC), Arizona, for reliability and accuracy testing. All GH P2 test projectiles reached their targets with 2.9-meter median radial miss distance. All six projectiles reached their intended targets and detonated.
- In September 2012, YTC personnel fired 12 Increment Ib projectiles in developmental testing for Sequential Environmental Test-Safety 1 (SET-S1). All rounds completed environmental conditioning (logistic and tactical vibration and thermal soak) prior to firing, and were fired at pressures above the normal operational envelope. Two projectiles failed to guide and traveled to the ballistic impact point. Ten projectiles reached their targets with a 1.5-meter median radial miss distance.
- In October 2012, the Army fired 25 environmentally-conditioned projectiles at YTC to support validation of the ballistic firing tables, verify that Excalibur Increment Ib meets performance requirements, and provide

live fire target assessment data (Sequential Environmental Test-Performance 1 (SET-P1)).
- The Increment Ib Milestone C decision is scheduled for December 2012, and the IOT&E is scheduled for April 2013.

Assessment

Increment Ia

- Excalibur Increment Ia-2 reliability in OEF is 90 percent (according to the Program Office) and Lot Acceptance Tests conducted in November and December 2011, and February 2012, had 24 of 24 reliable projectiles.

Increment Ib

- Increment Ib has the same base and warhead as Increment Ia-2, and is expected to have the same terminal ballistic characteristics and lethality as Increment Ia-2.
- Since the GH P2 median radial miss distance is comparable to the Increment Ia IOT&E (unjammed) miss distance (3 meters), Increment Ib is anticipated to meet the 10-meter accuracy requirement and be as accurate as Increment Ia.
- Since external differences between Excalibur Increments Ia and Ib are minor and units are expected to use the same tactics, techniques, and procedures, Increment Ib is anticipated to be as effective as Increment Ia.
- Of the 25 SET-P1 rounds fired, 22 hit the target with a median miss distance of 1.38 meters and 3 were duds. With regards to reliability, there were six failures in 31 rounds (including the GH-2 rounds). This gives a point estimate of 0.81 and a 21.8 percent confidence that they have met their growth curve target of 0.84. The program will need to complete root cause analysis before an assessment can be made as to whether the program can meet its 90 percent reliability requirement.

Recommendations

- Status of Previous Recommendations. The Army is addressing the previous recommendations.
- FY12 Recommendations.
  1. The Army should continue Increment Ib reliability growth through completion of the developmental test.
  2. The program will need to complete root cause analysis before an assessment can be made as to whether the program can meet its 90 percent reliability requirement.

Global Combat Support System – Army (GCSS-Army)

Executive Summary

- The Global Combat Support System – Army (GCSS-Army) Release 1.1 is operationally effective, operationally suitable, and survivable against cyber threats. DOT&E recommendations from the June 2012 IOT&E report included continued test and evaluation for future upgrades, monitoring scalability as the user population increases, and achieving financial auditability no later than 2017.
- The Army Test and Evaluation Command (ATEC) will participate in the Lead Site Verification Test in January 2013 to evaluate GCSS-Army's operational effectiveness, operational suitability, and survivability for use by the Army National Guard, Army Reserves, and Directorate of Logistics.

System

- GCSS-Army is an information technology system made up of commercial off-the-shelf and non-developmental software and server hardware.
- The core functionality of GCSS-Army comes from the adaptation of a commercially-available Enterprise Resource Planning (ERP) system. The ERP system integrates internal and external management information across an entire organization, including finance/accounting, manufacturing, sales and service, and customer relationship management, and automates this activity with an integrated software application.
- The hardware component of GCSS-Army is limited to the production server in Redstone, Alabama, and the Continuity of Operation server in Radford, Virginia.
- The GCSS-Army program includes the Army Enterprise Systems Integration Program (AESIP) that provides the enterprise hub services, centralized master data management, and cross functional business intelligence and analytics for the Army ERP solutions, including the General Fund Enterprise Business System and Logistics Modernization Program.
- GCSS-Army executes finance actions and thus is subject to the 2010 National Defense Authorization Act requirements to be auditable by 2017.

Mission

Army logisticians will use this system to access information and exchange operational logistics data related to tactical maintenance, materiel management, property accountability, tactical financial management, and logistics planning.

Major Contractors

- ERP Solution Component: Northrop Grumman Space and Mission Systems Corporation – Carson, California
- AESIP Component: Computer Sciences Corporation – Falls Church, Virginia

Activity

- DOT&E published an IOT&E report on GCSS-Army Release 1.1 in June 2012 based on the following three test events. These events were conducted in accordance with the DOT&E-approved test plan.
  - ATEC Release 1.1 testing conducted from August through October 2011. The 2nd Heavy Brigade Combat Team, 1st Armored Division, at Fort Bliss, Texas, and Defense Finance and Accounting Office at Rome, New York, participated in the IOT&E.
  - The GCSS-Army Cyber Threat Test conducted by the U.S. Army Threat System Management Office from September 2011, and the Program Management Office's corrective actions up through March 2012.
  - A Continuity of Operation demonstration conducted by the GCSS-Army and AESIP product manager in November 2011, which evaluated the system's ability to restore operations in the event of a declared disaster at the production server in Redstone Arsenal, Alabama.

- DOT&E and ATEC are planning to conduct or participate in a series of test events to address the recommended changes listed in the DOT&E-published IOT&E report.
  - Lead Site Verification Test at the National Guard, Army Reserve, and the Directorate of Logistics module in January 2013.
  - Test for scalability of GCSS-Army's ability to support the entire Army when the loading tool can be developed, verified, validated, and accredited.
  - Test for future upgrades as the program manager develops new functions. A Risk Assessment will determine the scope of the test in accordance with the DOT&E-published Guidelines for Operational Test and Evaluation of Information and Business Systems memorandum.

Assessment

DOT&E evaluated GCSS-Army Release 1.1 as operationally effective, operationally suitable, and survivable against cyber threats. DOT&E recommended the Army address the following.

- The Army conducted IOT&E with 545 users, compared to the total expected user population of 168,000 when fully deployed.
- The Army had not developed GCSS-Army versions for Army Reserve and National Guard units at the time of the IOT&E.
- The 2010 National Defense Authorization Act requires financial audibility by 2017. GCSS-Army had not achieved this requirement at the time of IOT&E.

Recommendations

- Status of Previous Recommendations. The Army is making progress implementing the previous recommendations.
- FY12 Recommendations.
  1. The Army needs to take steps to achieve financial auditability no later than 2017.
  2. The Army should continue to collect data for computational (server capacity, storage, and bandwidth) and human factors (help desk responsiveness, overhead labor and communication costs, and data noise) impacts of an increased user base. Use such data to establish a pattern of demand on the system, so that future demand can be adequately anticipated and resourced as more users come online.
  3. The Army should conduct test and evaluation when the software is developed for Army Reserve and National Guard units in accordance with the September 2010 DOT&E-published Guidelines for Operational Test and Evaluation of Information and Business Systems memorandum.

Joint Land Attack Cruise Missile Defense Elevated Netted Sensor System (JLENS)

Executive Summary

- The Joint Land Attack Cruise Missile Defense Elevated Netted Sensor System (JLENS) program experienced a critical Nunn-McCurdy cost breach due to an FY12 budget decision to eliminate procurement of all production systems. USD(AT&L) directed the Army to continue with a limited development program using the two existing JLENS developmental orbits, but did not restore funding for production systems. The Army is continuing to plan and execute a reduced JLENS test program to evaluate JLENS technologies and capabilities as directed by USD(AT&L). The Army Test and Evaluation Command (ATEC) will conduct a limited assessment of JLENS operational capabilities and limitations in FY13.
- During the initial phases of contractor functional verification and government developmental testing in 2011, the JLENS demonstrated surveillance and fire control radar detection and tracking performance that exceeded system technical specifications for fixed-wing and cruise missile air-breathing targets in a controlled test environment. The system was operated and maintained by contractor personnel during these test events. Testing identified problems with operator controls and displays, non-cooperative target recognition, friendly aircraft identification, and fire control radar software and track stability; these problems require future improvement.
- During the developmental integrated fire control test phase in April 2012, an integrated JLENS orbit supported a series of simulated missile flight test engagements of airborne targets with an operational Army air defense missile system. This phase concluded with a successful live missile flight test that destroyed a fixed-wing target drone aircraft in a controlled test environment.
- The Army and Navy conducted a joint JLENS Navy Integrated Fire Control – Counter Air (NIFC-CA) missile flight test event at White Sands Missile Range, New Mexico, in late September 2012. The JLENS provided integrated fire control targeting information to a Navy Aegis-based missile system using Cooperative Engagement Capability (CEC) datalinks to successfully engage and destroy a surrogate cruise missile aerial target.
- Based on data collected during developmental testing, JLENS system-level reliability is not meeting program reliability growth goals. Both software and hardware reliability problems contribute to low system reliability.

System

- A JLENS orbit consists of separate surveillance and fire control radar systems individually mounted on 74-meter tethered aerostat balloons that operate at altitudes up to 10,000 feet above mean sea level.
- A 180,000-pound mobile mooring station and tether system is used to launch, recover, and secure each aerostat system. The aerostat tether system provides radar control and data transfer links to supporting ground control and data processing stations. JLENS is deployable to pre-planned operational sites that have been prepared to support mobile mooring station operations. Five days are required to transition between fully operational status and a transportable configuration. Operators control the radar, process data, and transmit radar track information from mobile communication and control stations co-located with the mobile mooring stations. A mobile power generation and distribution system and associated ground equipment support each JLENS orbit.

Mission

- Army air defense units equipped with the JLENS provide persistent air and missile threat warning to friendly forces, target identification, target cueing for airborne interceptor aircraft, and precision targeting information to ground-based air defense weapons systems.
- Primary JLENS air-breathing targets include all fixed- and rotary-wing aircraft, unmanned aerial vehicles, and land attack cruise missiles. Secondary targets include surface moving targets, large caliber rockets, and tactical ballistic missiles.

Major Contractor

Raytheon Integrated Defense Systems – Andover, Massachusetts

Activity

- The JLENS program experienced a critical Nunn-McCurdy cost breach due to an FY12 budget decision to eliminate procurement of all production systems. Following a Nunn-McCurdy review, USD(AT&L) rescinded the JLENS Acquisition Program Baseline and directed the Army to continue with a reduced JLENS test program using the two existing JLENS developmental orbits. The focus of the reduced test program is to improve airborne and surface moving target capabilities in advance of possible JLENS participation in an FY14 Combatant Commander exercise. USD(AT&L) did not authorize the program to complete the previously planned system development program or to proceed to a Milestone C or production decision.
- Based on the USD(AT&L) direction, the Army revised the JLENS operational test strategy, transitioning from the previously planned Milestone C operational assessment to a limited Early User Test (EUT) in FY13. The purpose of the EUT event is to assess JLENS operational capabilities and limitations in advance of the potential FY14 Combatant Commander exercise. During this limited assessment, Soldier operators will conduct missions with contractor support. All system maintenance support will be provided by contractor personnel. The Army has scheduled execution of EUT operational flight test scenarios for November 2012, with additional modeling and simulation events planned in March 2013. Since no further JLENS production is currently authorized, a JLENS IOT&E event will not be required.
- The Army completed the first phase of JLENS contractor functional verification testing and government test phase in December 2011 at the Utah Test and Training Range (UTTR). This phase included contractor and government developmental testing of the surveillance radar and fire control radars installed on their individual aerostat systems. The primary focus of these test events was to develop an initial capability for the surveillance and fire control radars to independently detect, identify, and track airborne targets. This phase also provided initial information on system reliability.
- From February through April 2012, the Army conducted a series of developmental integrated fire control tests with both radars operating as a single, integrated orbit to support simulated air defense missile engagements using an operational Army air defense missile system. This test phase concluded with a live missile flight test engagement against a target drone.
- The program entered the second phase of developmental testing in August 2012. This phase focused on improving orbit-level stability and technical maturity for airborne and surface moving target detection, identification, and tracking, including operations in a basic electronic attack environment. New capabilities under development in this phase included interoperability with additional datalink systems such as CEC, Integrated Broadcast Service (IBS), Joint Range Extension Application Protocol C (JREAP C), and Tactical Voice Communications. The phase also included Soldier operator and maintenance training activities, although contractor personnel continued to operate and maintain the system. This test phase was completed in September 2012 and data analysis is in progress.
- In September 2012, the JLENS system supported a NIFC-CA Live Fire Demonstration missile flight test event at White Sands Missile Range.

Assessment

- During the initial phases of contractor functional verification and government developmental testing in 2011, the JLENS demonstrated surveillance and fire control radar detection and tracking performance that exceeded system technical specifications for fixed-wing and cruise missile air-breathing targets in a controlled test environment. Contractor personnel operated and maintained the system during these test events.
- Testing showed that the fire control radar consistently provided fire control quality tracking data that were sufficient to support air defense missile engagements. The system also demonstrated a limited target identification capability that partially met requirements and basic interoperability with other air defense systems using Link 16 data transfer systems. Testing included a successful demonstration of the fully-deployed aerostat tether system, including power and fiber-optic data transmission paths. The test also identified critical performance areas for improvement to include: non-cooperative target recognition, friendly aircraft identification capabilities, fire control radar software stability, and target track consistency. During this test phase, the system was operated primarily by contractor personnel using non-production representative engineering control systems and operator interfaces.
- During the developmental integrated fire control test phase in April 2012, an integrated JLENS orbit supported a series of simulated missile flight test engagements of airborne targets with an operational Army air defense missile system. These tests verified that JLENS detection and tracking technical performance continued to mature and were sufficient to support basic air defense missile engagements. This phase concluded with a successful live missile flight test that destroyed a target drone aircraft in a controlled test environment. During this phase, the JLENS system was operated primarily by contractor personnel using non-production representative engineering control systems and operator interfaces.
- During the joint JLENS NIFC-CA missile flight test at White Sands Missile Range, the JLENS provided integrated fire control targeting information to a Navy Aegis-based missile system using CEC datalinks to successfully engage and destroy a surrogate cruise missile aerial target.
- Based on data collected during developmental testing, JLENS system-level reliability is not meeting program growth goals. At the beginning of the DT-2 test phase in August 2012, the Army assessed orbit level reliability to be 21 hours Mean Time Between System Abort (MTBSA), well below the 108 hours MTBSA necessary to meet operational reliability

and availability requirements. Both software and hardware reliability problems contribute to low system reliability.

Recommendations

- Status of Previous Recommendations. This is the first annual report for this program.
- FY12 Recommendations. The Army should:
  1. Complete the planned JLENS EUT and provide an operational capabilities and limitations report prior to initiating a Combatant Command exercise.
  2. Develop a reliability improvement plan to address poor system-level reliability prior to a JLENS fielding decision.

Joint Light Tactical Vehicle (JLTV)


AM General JLTV


Lockheed Martin Systems JLTV


Oshkosh Defense JLTV

Executive Summary

- DOT&E approved the Joint Light Tactical Vehicle (JLTV) Test and Evaluation Master Plan (TEMP) in July 2012. The TEMP addresses the test and evaluation strategy to support the selection of a single vendor to produce JLTV low-rate initial production vehicles, and includes a reliability growth plan and adequate operational and live fire testing.
- In August 2012 the USD(AT&L) granted approval for the program to enter Engineering Manufacturing and Development (EMD) at Milestone B.
- Based on JLTV prototype performance in Technology Development (TD) phase tests, demonstrating the reliability threshold requirement of 2,400 Mean Miles Between Operational Mission Failure is dependent on the vendors designing reliability into vehicles and successfully integrating government-furnished mission equipment in the vehicles.
- The Army underbody threat size requirements are equivalent to those of the Mine Resistant Ambush Protected (MRAP) All-Terrain Vehicle (M-ATV) without an underbody improvement kit. The ability to achieve this level of protection while satisfying other JLTV requirements is not yet known.
- The program awarded contracts to Oshkosh Corporation, AM General, and Lockheed Martin for the EMD phase of the JLTV Family of Vehicles (FoV) program in August 2012. The program has allotted 33 months for the EMD phase. The contractors will deliver 22 full-up prototypes per contractor in the 12 months after the EMD contract is awarded for the 14-month government test program.

System

- The JLTV FoV is the Marine Corps and Army partial replacement for the High Mobility Multi-purpose Wheeled Vehicle (HMMWV). The Services intend the JLTV to provide increased crew protection against IED and underbody attacks, improved mobility, and higher reliability than the HMMWV.
- The JLTV FoV consists of two vehicle categories: the JLTV Combat Tactical Vehicle (CTV), designed to seat four passengers; and the JLTV Combat Support Vehicle (CSV), designed to seat two passengers.
- The JLTV CTV has a 3,500-pound payload and three mission package configurations:
  - Close Combat Weapons Vehicle
  - General Purpose Vehicle
  - Heavy Guns Carrier Vehicle
- The JLTV CSV has a 5,100-pound payload and two mission package configurations:
  - Utility Prime Mover
  - Shelter Carrier
- The JLTV program is using a competitive acquisition strategy. During the EMD phase, the program will test and assess at least three vendors' FoVs.

Mission

- Military units employ JLTV as a light tactical wheeled vehicle to support all types of military operations. JLTVs will be used by airborne, air assault, light, Stryker, and heavy forces as reconnaissance, maneuver, and maneuver sustainment platforms.
- Small ground combat units employ JLTV in combat patrols, raids, long-range reconnaissance, and convoy escort.

Major Contractors

- Oshkosh Corporation – Oshkosh, Wisconsin
- AM General – South Bend, Indiana
- Lockheed Martin Corporation – Dallas, Texas

Activity

- The program completed TD phase testing in 4QFY11 in accordance with the DOT&E-approved Test and Evaluation Strategy (TES).
- In January 2012, the program released the Request for Proposal to industry to solicit vendor participation in the JLTV EMD phase.
- The Joint Requirements Oversight Council approved the JLTV Capability Development Document and designated the Army as lead Service for the program in March 2012.
- DOT&E approved the JLTV TEMP in July 2012. The TEMP addresses the TES to support the selection of a single vendor to produce JLTV low-rate initial production vehicles, and includes a reliability growth plan and adequate operational and live fire testing.
- The USD(AT&L) approved Milestone B in August 2012, which permitted the program to enter EMD.
- The program awarded contracts to Oshkosh Corporation, AM General, and Lockheed Martin for the EMD phase of the JLTV FoV program in August 2012. The program has allotted 33 months for the EMD phase. The contractors will deliver 22 full-up prototypes per contractor in the 12 months after the EMD contract is awarded for the 14-month government test program.

Assessment

- Based on JLTV prototype performance in TD phase tests, demonstrating the reliability requirement of 2,400 Mean Miles Between Operational Mission Failure during EMD is dependent on the vendors designing reliability into their vehicles and successfully integrating government-furnished mission equipment in the vehicles.
- The Army underbody threat size requirements are equivalent to the threat size requirements of the M-ATV without an underbody improvement kit. The ability to achieve this level of protection while satisfying other JLTV requirements is not yet known.
- The planned EMD reliability growth testing and corrective action periods have limited time to identify and resolve failure modes prior to initiation of the Limited User Test.
- The Limited User Test and live fire test programs have adequate quantities and variants of the JLTV prototypes to assess the JLTV FoV operational capabilities and survivability.

Recommendations

- Status of Previous Recommendations. The program addressed all previous recommendations.
- FY12 Recommendations. None.

MQ-1C Gray Eagle Unmanned Aircraft System (UAS)

Executive Summary

- The Army conducted the Gray Eagle IOT&E at Edwards AFB, California, and the National Training Center (NTC), Fort Irwin, California, July 30 through August 17, 2012.
- The Army conducted the IOT&E in accordance with the DOT&E-approved Test and Evaluation Master Plan and test plan.
- DOT&E is completing a Beyond Low-Rate Initial Production (BLRIP) report supporting the Gray Eagle Full-Rate Production decision planned for April 2013. In that report, DOT&E concludes the Gray Eagle-equipped unit was effective at operating the MQ-1C system and has the potential to provide effective support to combat units, but the Army needs to continue to develop the tactics, techniques, and procedures; the training; and the doctrine required to effectively integrate this capability into combat operations. The Gray Eagle system is operationally suitable. The Gray Eagle meets its crew force protection survivability requirements by providing up-armored capability to the cab of the vehicles transporting the Ground Control Stations during company movement. The Gray Eagle aircraft is not survivable in a mid- to high-threat environment.

System

The Gray Eagle Unmanned Aircraft System (UAS) is composed of the following major components:

- Twelve unmanned aircraft each with a Common Sensor Payload (CSP) with an electro-optical/infrared with a Laser Range Finder/Laser Designator capability, a STARLite Synthetic Aperture Radar/Ground Moving Target Indicator (SAR/GMTI) sensor payload, and an Air Data Relay (ADR) control capability
- Each aircraft is equipped with a Standard Equipment Package that includes a communications relay package, Identification Friend-or-Foe equipment, and Air Traffic Control radios
- Each aircraft has the ability to carry up to four Hellfire P+ missiles
- Five Ground Control Stations designated as the One System Ground Control Station (OSGCS)
- Five Tactical Common Datalinks (TCDL) Ground Data Terminals
- One Satellite Communications (SATCOM) Ground Data Terminal
- Six SATCOM Air Data Terminals
- Two Automatic Take-off and Landing Systems, which consist of four Take-off and Landing System-Tracking Systems and antennas

Mission

Commanders employ Gray Eagle Companies to execute Reconnaissance, Surveillance, Security, Attack, and Command and Control missions in support of assigned Division Combat Aviation Brigade, Fires Brigade, Battlefield Surveillance Brigade, Brigade Combat Teams, and other Army and Joint Force units based upon the Division Commander's mission priorities.

Major Contractor

General Atomics Aeronautical Systems, Inc., Aircraft Systems Group – Poway, California

Activity

- The Gray Eagle UAS participated in the Apache Block 3 IOT&E in March through April 2012, at the NTC in Fort Irwin, California, to conduct Manned-Unmanned Teaming operations. A single Gray Eagle UAS with associated flight crew and personnel provided mission support to the IOT&E from Edwards AFB, California.
- In July 2012, and as a result of the direction received from the Low-Rate Initial Production (LRIP) III Acquisition Decision Memorandum, the project manager for UAS requested the Army Aviation Center seek a deferral of the requirement to meet the Reliability Key System Attributes (KSAs) and the Sustainment Key Performance Parameter (KPP) from IOT&E to FOT&E. The Army deferred the requirement of meeting the KSAs on August 16, 2012. The Joint Requirements Oversight Council approved the deferral of meeting the KPP on November 16, 2012.

- The Army conducted the Gray Eagle IOT&E at Edwards AFB, California, and the NTC, Fort Irwin, California, July 30 through August 17, 2012, in accordance with the DOT&E-approved Test and Evaluation Master Plan and test plan. The Army based the IOT&E unit at Edwards AFB, and from there it conducted missions in support of the Brigade Combat Team conducting a training rotation at the NTC approximately 130 kilometers away. The IOT&E unit flew 1,090 flight hours and conducted missions at operational ranges exceeding 150 kilometers. The IOT&E unit routinely flew aircraft between 8,000 and 13,000 feet mean sea level (MSL) with a maximum altitude being flown of 24,500 feet MSL.
- There were eight Hellfire missile engagements during IOT&E. Six were cooperative engagements with Apache helicopters, meaning one aircraft provided the lasing of the target while the other aircraft launched the missile. Two engagements were autonomous, meaning the Gray Eagle provided the lasing of the target and launched the missile on its own. All eight missile engagements hit the intended target.
- DOT&E is completing a BLRIP report supporting the Gray Eagle Full-Rate Production decision planned for April 2013.

Assessment

- During IOT&E, the Gray Eagle-equipped unit was effective at operating the MQ-1C system and demonstrated the potential to provide effective support to combat units, but the Army has not effectively integrated this capability into combat operations. Army integration of Gray Eagle into employment concepts, and development of tactics, techniques, and procedures are not mature and training afforded to the IOT&E unit before the test was not complete. Soldiers did not receive training on fundamentals of reconnaissance, mission planning, set-up and operation of radios, distribution of video, STARLite SAR/GMTI capabilities and operation, or employment of Gray Eagle.
- The Gray Eagle system has more capability and functionality today than it demonstrated in previous operational tests. Increases in capability demonstrated during the 2012 IOT&E include:
  - The CSP providing the electro-optical/infrared with a Laser Range Finder/Laser Designator capability
  - A STARLite SAR/GMTI payload
  - The ability to conduct aircraft operations via encrypted TCDL, SATCOM datalink, as well as the ADR aircraft control capability
- The IOT&E unit completed 223 of 307 attempted missions during test, resulting in a mission success rate of 73 percent.
- The Gray Eagle system is operationally suitable. During IOT&E, the Gray Eagle unit demonstrated its ability to meet its operational tempo requirement to provide three simultaneous and continuous missions (24-hour continuous reconnaissance, 24-hour continuous armed reconnaissance, and two 5-hour attack missions in a 24-hour period). The Gray Eagle system demonstrated a Combat Availability of 81 percent, exceeding the Sustainment KPP requirement of 80 percent. The unit achieved the Combat Availability requirement in spite of failing to meet its reliability requirements. The IOT&E demonstrated that the modeling assumptions that established the reliability requirements thresholds were not valid. As a result, the Army is reassessing whether or not the reliability KSAs need to be changed. Those modified reliability requirements, if made, are planned to be tested in FOT&E.
- During the IOT&E, the Gray Eagle demonstrated KSA Mean Time Between System Abort (MTBSA) compared to the deferred MTBSA requirements of 44 hours versus 150 hours for the OSGCS, 55 hours versus 100 hours for the aircraft, 218 hours versus 500 for the CSP, and 97 hours versus 500 hours for the STARLite SAR/GMTI.
- The Gray Eagle Company depended heavily on the maintenance expertise of Contractor Field Service Representatives.
- During the IOT&E, remote video from the Gray Eagle to the One System Remote Video Terminal (OSRVT) was generally not available, not clear, and not reliable. Integration of the Gray Eagle with a reliable remote video display system is not complete.
- The IOT&E unit demonstrated effective target detection and recognition capability using the electro-optical/infrared sensor with Laser Range Finder/Designator.
- The Hellfire P+ missile is fully integrated into the Gray Eagle system when using the TCDL and SATCOM datalinks. The Army has not demonstrated Hellfire engagements via the ADR datalink in developmental or operational testing.
- The Automatic Take-off and Landing System worked as designed.
- The Gray Eagle is vulnerable to computer network attack.
- The Gray Eagle meets its crew force protection survivability KPP requirement by providing up-armored capability to the cab of the vehicles transporting the ground control stations during company movement. Testing indicates that the Gray Eagle aircraft is not survivable in a mid- to high-threat environment. The aircraft can be detected at operational altitudes visually, acoustically, by late-model man-portable air defense systems, and by threat radar systems.
- The operator's manual is not current and in some cases not accurate.
- The design of the OSGCS shelter has a number of features that reduce operator efficiency and increase operator stress and fatigue: volume control of radios, OSGCS start-up procedures, procedures for operators to establish SATCOM and ADR datalinks, work station climate control, and poor ergonomics of the OSGCS operator's joy stick controller.
  - Operators are not able to control the volume on any of the radios within the OSGCS. On numerous occasions during missions, the air traffic control radio calls would drown out the operator's ability to hear other communications on the tactical radio networks.
  - The OSGCS start-up procedures entail 191 checklist steps and require up to 2 hours to execute.

- Procedures for operators to establish SATCOM and ADR datalinks are numerous and complex in nature. If the operator does not follow the prescribed sequence, they have to re-execute the procedure in its entirety, taking up to 45 additional minutes to complete the task.
- The computers and avionics within the OSGCS require air conditioning to maintain normal operation. Air conditioning controls have been improved; however, in order to stay warm, OSGCS operators continue to wear hats, gloves, and cold-weather gear even in hot weather environments.
- Operator controls are not efficient. OSGCS employs a joystick that has no triggers or buttons that would allow one-handed control of the payload or aircraft. Both hands are required for many basic tasks as the operator provides inputs to both the joystick and the keyboard while operating the system. A cyclic-type joystick, such as those found in Army helicopters, would allow for one-handed multifunction operation of the system.

Recommendations

- Status of Previous Recommendations. The Army addressed four of the seven previous recommendations. Outstanding previous recommendations include:
  1. The Army should develop, optimize, and publish standardized procedures for the OSRVT terminal.
  2. The Army should revise and expand the training program and update the operator's manual.
  3. The Army should improve the Ground Control Shelter design.
- FY12 Recommendations.
  1. The Army should:
     - Continue to develop doctrine; employment concepts; and tactics, techniques, and procedures to fully integrate the Gray Eagle unit into combat operations.
     - Train operators on fundamentals of reconnaissance, mission planning, set-up and operation of radios, distribution of video, and optimal employment of the Gray Eagle.
     - Continue to develop and publish standardized procedures for distribution of Gray Eagle video to OSRVT and institute training across the Army to facilitate integration of Gray Eagle into supported unit operations.
     - Revise and expand the training program for operators and update the operator's manual.
     - Modify the personnel plan to retain or offset the anticipated loss of Contractor Field Service Representative support.
     - Refine and train procedures for collection and exploitation of SAR/GMTI imagery.
  2. The Product Office should:
     - Simplify, and to the greatest extent possible, automate routine operator tasks. The 2-hour, 191 checklist steps required to start the Ground Control Station should be streamlined and be made less susceptible to operator errors.
     - Simplify procedures for operators to establish SATCOM and ADR datalinks.
     - Qualify the ADR datalink for employment of Hellfire missiles.
     - Improve OSGCS functionality by increasing operator control of radio volume, temperature, and joy stick functionality.

Paladin Integrated Management (PIM)

Executive Summary

- DOT&E approved the Paladin Integrated Management (PIM) Engineering and Manufacturing Development Test and Evaluation Master Plan on March 5, 2012.
- In 1QFY12, PIM completed Phase I government developmental testing with five prototype howitzers and two prototype ammunition carriers. The howitzer reliability estimate from Phase I reliability, availability, and maintainability (RAM) missions was 45 hours Mean Time Between System Abort (MTBSA) compared to a requirement of 62 hours.
- In July 2012, PIM vehicles commenced Phase II developmental testing in preparation for a Limited User Test scheduled for October 31 through November 8, 2012, to support a June 2013 Milestone C decision.
- Testing to characterize the protection provided by M109 Family of Vehicles (FoV) armor configurations began in August 2012 and is scheduled to continue through the end of the year.
- In 2011, DOT&E raised concerns regarding the M109 FoV force protection and survivability requirements. As a result, the Army improved the systems' ballistic vulnerability requirements, and OSD directed the Army to design, develop, and test an underbelly kit to address operationally-relevant underbody blast threats.
- OSD also directed the Army to characterize the expected impact of the objective-level underbelly kit on howitzer performance and vehicle RAM by integrating such a kit into the PIM program's development and testing, and planned Production Qualification Testing.
- The program's current plans are schedule driven, with limited time for correction of deficiencies identified in developmental testing and little flexibility with individual component test schedules. The program must wait for the production of low-rate initial production (LRIP) vehicles before verifying most corrective actions.

System

- The M109 FoV PIM consists of two vehicles, the Self-Propelled Howitzer (SPH) and Carrier, Ammunition, Tracked (CAT).
- The M109 FoV SPH is a tracked, self-propelled 155 mm howitzer designed to improve sustainability over the legacy M109A6 howitzer fleet. The full-rate production howitzers will have a newly designed hull, modified Bradley Fighting Vehicle power train and suspension, and a high-voltage electrical system. Operated by a crew of 4, the howitzer is capable of achieving ranges of 22 kilometers using standard projectiles and 30 kilometers using rocket-assisted projectiles.

- The M109 FoV CAT supplies the howitzer with ammunition. The full-rate production ammunition carriers will have a common chassis with the SPH. The ammunition carriers are designed to carry 12,000 pounds of ammunition in various configurations and a crew of 4 Soldiers.
- The Army intends to employ the M109 FoV as part of a Fires Battalion in the Armored Brigade Combat Team and Artillery Fires Brigades with the capability to support any Brigade Combat Team.
- The Army plans to field 580 sets of the M109 FoV with full-rate production vehicles beginning in FY17.

Mission

Field Artillery units will use the M109 FoV to destroy, neutralize, or suppress the enemy by providing massed and precision indirect fire effects in support of maneuver units in multiple levels of conflict to include major combat operations and irregular warfare.

Major Contractor

BAE Systems – York, Pennsylvania

Activity

- In 1QFY12, PIM completed Phase I government developmental testing with five prototype howitzers and two prototype CAT platforms. Phase I SPH testing at Yuma Test Center, Arizona, included five RAM missions (firing 223 rounds and moving 17.4 miles per firing mission – equivalent

to 1 combat day at the Paladin operational tempo), firing performance tests.
- Testers at the Aberdeen Test Center, Maryland, conducted Phase I testing of both vehicles to determine compliance with performance specifications. A 2,400-mile demonstration with the CAT was terminated early because of a transmission failure.
- In 2011, DOT&E raised concerns regarding the M109 FoV force protection and survivability requirements. As a result, the Army improved the systems' ballistic vulnerability requirements, and OSD directed the Army to design, develop, and test an underbelly kit to address operationally-relevant underbody blast threats.
- OSD also directed the Army to characterize the expected impact of the objective-level underbelly kit on howitzer performance and vehicle RAM by integrating such a kit into the PIM program's development and testing, and planned Production Qualification Testing.
- DOT&E approved the PIM Test and Evaluation Master Plan on March 5, 2012.
- Prototype SPHs completed refurbishment in June 2012, and entered Phase II government developmental testing, which completes production prove-out testing with prototype vehicles. Phase II included an additional 10 RAM missions using the Heavy Brigade Combat Team operational tempo, the logistics demonstration, and software verification. Phase II completed in mid-October 2012.
- Testing to characterize the protection provided by M109 FoV armor configurations began in August 2012 and is scheduled to continue through the end of the calendar year.
- The Army has scheduled a PIM Limited User Test for October 31 through November 8, 2012, to support a Milestone C decision in June 2013. The IOT&E is scheduled for 4QFY16.

Assessment
- The current program is schedule-driven, with limited time for correction of deficiencies identified in developmental testing and little flexibility in schedules for individual tests. Most corrective actions must wait for testing with LRIP vehicles to verify the corrective action.
- The howitzer reliability estimate from Phase I RAM missions, 45 hours MTBSA, is the initial point on a reliability growth curve designed to grow vehicle reliability above the 62-hour MTBSA needed to meet the reliability requirement.
- As Phase I RAM testing progressed, vehicle discrepancies increased as PIM subsystems had problems withstanding repeated gun shock. Legacy subsystems, including the Paladin Digital Fire Control System (PDFCS), demonstrated fewer gun-shock generated discrepancies.
- The PDFCS experienced frequent failures attributed to the Muzzle Velocity Radar System (MVRS). A software modification corrected a timing problem between MVRS and PDFCS, which is believed to have caused those failures.
- In Phase I testing, the PIM prototype SPH demonstrated the ability to conduct conventional fire missions, and verify compatibility with current 155 mm ammunition. In early testing with the initial transmission, the SPH failed to meet the climbing requirement. Subsequent testing has not demonstrated the ability to meet this requirement with confidence using correct fluid levels per the Technical Manual.
- Vehicle deficiencies were identified during Phase II RAM testing with the automotive subsystems of the SPH. These problems prevented the vehicle from conducting required short-duration survivability movements in a timely manner.
- After the critical design review, the program manager identified a number of corrective action, producibility, and obsolescence (CPO) engineering changes to the PIM design that will be implemented between LRIP and the IOT&E. The schedule for development, test, and implementation of those CPO changes is high-risk and challenging.

Recommendations
- Status of Previous Recommendations. This is the first annual report for this program.
- FY12 Recommendations. The Army should:
  1. Provide an LRIP-configured prototype as early as possible to continue characterizing armor performance, address critical ballistic vulnerability data voids, and provide time for implementation of corrective actions before entering full-up system-level testing.
  2. Ensure that CPO changes are fully qualified in system-level testing rather than relying solely on component-level qualification before implementing them in the LRIP vehicles scheduled for the IOT&E.

Patriot Advanced Capability-3 (PAC-3)

Executive Summary

- The Army began the Post-Deployment Build-7 (PDB-7) Limited User Test (LUT) operational test in FY12. The PDB-7 LUT included hardware-in-the-loop (HWIL) testing, sustained operations testing, and a combined missile flight test that consolidated three individual missile flight tests into one campaign.
- The Army conducted five major developmental Patriot flight test missions and the PDB-7 Developmental Test and Evaluation (DT&E) in FY12.
- The Missile Defense Agency conducted an integrated flight test of the Ballistic Missile Defense System (BMDS) in October 2012, during which Patriot engaged and killed a cruise missile target and a tactical ballistic missile target in the debris field caused by another BMDS intercept.
- In the seven U.S. developmental and operational flight tests conducted in FY12, Patriot achieved successful intercepts of six short-range ballistic missile targets and five air-breathing threat/cruise missile targets using Patriot Advanced Capability-3 (PAC-3) and Guidance Enhanced Missile (GEM) missiles.
- The Army also conducted five flight tests for an international Foreign Military Sales (FMS) customer, during which Patriot intercepted four of five tactical ballistic missile targets and three of three air-breathing threat/cruise missile targets. The fifth FMS flight test concurrently successfully fulfilled a long standing PAC-3 Engineering Manufacturing and Development phase requirement.

System

- Patriot is a mobile air and missile defense system that counters missile and aircraft threats. The system includes the following:
  - C-band phased-array radars for detecting, tracking, classifying, identifying, and discriminating targets
  - Battalion and battery battle management elements
  - Communications Relay Groups and Antenna Mast Groups for communicating between battery and battalion assets
  - A mix of PAC-3 hit-to-kill missiles and PAC-2 blast fragmentation warhead missiles for negating missile and aircraft threats
- The newest version of the PAC-3 missile is the Cost Reduction Initiative (CRI) missile. In addition, the Army is developing the PAC-3 Missile Segment Enhancement (MSE) missile with increased battlespace defense capabilities and improved lethality.
- Earlier versions of Patriot missiles include the Patriot Standard missile, the PAC-2 Anti-Tactical Missile, and the GEM family (includes the GEM-T and GEM-C missile variants intended to counter tactical ballistic missiles and cruise missiles, respectively).
- DoD intended the Medium Extended Air Defense System (MEADS) to replace the Patriot system. The DoD has decided not to field MEADS and plans to conclude the design and development phase of the program in FY13.

Mission

Combatant Commanders use Patriot to defend deployed forces and critical assets from missile and aircraft attack and to defeat enemy surveillance air assets (such as unmanned aerial vehicles) in all weather conditions, and in natural and induced environments.

Major Contractors

- Raytheon Integrated Defense Systems – Tewksbury, Massachusetts
- Lockheed Martin Missile and Fire Control – Grand Prairie, Texas

Activity

- In accordance with the DOT&E-approved Test and Evaluation Master Plan, the Army began the PDB-7 LUT on May 31, 2012, at White Sands Missile Range (WSMR), New Mexico. The PDB-7 LUT is expected to end in November 2012 with the completion of the PDB-7 LUT regression test.

- The Army conducted the PDB-7 LUT operational missile flight test (P7L-1/2/3) at WSMR in August 2012. During this test, Patriot:
  - Engaged and intercepted one tactical ballistic missile target with a ripple launch (firing of missiles in quick succession) of GEM-T/PAC-3 CRI missiles.
  - Engaged a second tactical ballistic missile target with a ripple launch of two PAC-3 missiles. This second tactical ballistic missile target self-destructed before the interceptors reached it; therefore, the endgame segment of the second tactical ballistic missile engagement was deemed a "No Test."
  - Engaged and intercepted a cruise missile target with a GEM-T missile in the debris field resulting from the destruction of the two tactical ballistic missile targets.
- The Army conducted the PDB-7 DT&E at WSMR from July 2011 to March 2012.
  - During PDB-7 flight test P7-4 in November 2011, Patriot engaged a short-range ballistic missile target with a ripple launch of two PAC-3 CRI missiles. The first PAC-3 missile intercepted the target.
  - During PDB-7 flight test P7-3 in November 2011, Patriot engaged a short-range ballistic missile target with a ripple launch of two GEM-T missiles. The first GEM-T missile intercepted the target.
  - During PDB-7 flight test P7-2 in November 2011, Patriot engaged two short-range ballistic missile targets with two ripple launches of GEM-T/GEM-C missiles. The first GEM-T missile of each ripple engagement intercepted its target.
  - During PDB-7 flight test P7-1 in March 2012, Patriot fired a GEM-T missile at one cruise missile target and a GEM-C missile at a second cruise missile target. Both Patriot missiles intercepted their targets.
- During the first Integrated Fire Control flight test (IFC-1) at the Utah Test and Training Range in April 2012, Patriot fired a PAC-3 CRI missile at a cruise missile target using a Joint Land Attack Cruise Missile Defense Elevated Netted Sensor System cue. The PAC-3 missile intercepted the target.
- During the first MEADS flight test, the Launcher/Missile Characterization Test at WSMR in November 2011, MEADS fired an MSE missile at a simulated target.
- During the FMS G-2 missile flight test at WSMR in March 2012, Patriot intercepted a cruise missile target with a GEM-T missile.
- During the FMS P-1/P-2 missile flight test at WSMR in March 2012, Patriot engaged a short-range ballistic missile target with a ripple launch of two PAC-3 missiles. The first PAC-3 missile intercepted the target.
- During the FMS G-3/G-6/G-7 missile flight test at WSMR in May 2012, Patriot failed to intercept a short-range ballistic missile target during the G-3 portion of the mission because of a missile launch sequence failure. As a result, the G-3 portion of the mission was repeated using a backup short-range ballistic missile target, which Patriot intercepted using a GEM-T missile. This was followed by the launch of another short-range ballistic missile target, which Patriot engaged using a ripple launch of two GEM-T missiles. The first GEM-T missile intercepted the target.
- During the FMS G-4/G-5 missile flight test at Eglin AFB, Florida, in June 2012, Patriot performed near-simultaneous intercepts over water of two air-breathing targets using GEM-T missiles.
- During the FMS P-3/P-4 missile flight test at WSMR in September 2012, Patriot engaged a short-range ballistic missile target with a ripple launch of two PAC-3 CRI missiles. The first PAC-3 missile intercepted the target. This mission concurrently fulfilled a long standing PAC-3 Engineering Manufacturing and Development phase requirement.
- During Flight Test Integrated-01 (FTI-01) in October 2012 at the Reagan Test Site, Patriot performed a near-simultaneous engagement of a short-range ballistic missile target with two PAC-3 interceptors and a cruise missile target with another PAC-3 interceptor. FTI-01 was the first integrated flight test with multiple firing elements (Aegis Ballistic Missile Defense [BMD], Terminal High-Altitude Area Defense [THAAD], and Patriot) engaging multiple ballistic missile and air-breathing targets in a realistic BMDS-level architecture. Patriot successfully intercepted both of its targets.

Assessment

- The HWIL phase of the PDB-7 LUT was to have included equal numbers of runs with and without simulated MSE missiles. All planned runs without MSE missiles were completed, but Patriot system availability problems led to only 20 percent of the MSE runs being accomplished. As a result, the effectiveness assessment of the Patriot PDB-7 system with MSE missiles will be limited until the Army conducts a dedicated HWIL test with simulated MSE missiles. Additional HWIL testing with MSE missiles is planned as part of PDB-7 regression testing scheduled to complete in November 2012.
- Data analysis is ongoing, but preliminary results indicate that Patriot training remains inadequate to prepare operators for complex Patriot engagements. This was true during the PDB-6.5 and PDB-6 LUTs as well. This problem was exacerbated in the PDB-7 LUT because many of the experienced Patriot operators in the test unit were understandably transferred to deploying units prior to the LUT, resulting in many inexperienced users and a high variability in Soldier proficiency across the test unit.
- Calculation of Patriot system reliability such as Mean Time Between Critical Mission Failure using field data is being investigated. Critical field data including total operating hours and numbers of critical mission failures for each Patriot battery major end item may not be accurate.
- During the PDB-7 LUT operational missile flight test (P7L-1/2/3), Patriot demonstrated the capability to search, detect, track, engage, and intercept both a tactical ballistic missile target and a cruise missile target with GEM-T missiles. Patriot intercepted the cruise missile target in the debris field caused by the intercept of the first tactical ballistic missile target and the self-destruction of the second tactical ballistic

missile target. However, the following problems were observed during this test:
- Patriot was to have engaged the first tactical ballistic missile target with two GEM-T missiles, but the launcher incorrectly reported a missile count of zero after the first GEM-T missile launched so a PAC-3 missile was launched instead.
- Patriot engaged the second tactical ballistic missile target with two PAC-3 missiles, but the target broke up before the missiles reached it. The cause of this target failure is under investigation.
- Patriot was to have had two GEM-T missiles available to engage the cruise missile target, but one could not be armed. The backup missile was not needed however, as the first GEM-T missile launched successfully and intercepted the target.
- Although the Patriot crews were not supposed to be notified when the targets were launched, a test conduct error led to them hearing the range communications network during the launches. It is unknown what effect, if any, this had on the test.
- The Patriot system met most of the test objectives during the PDB-7 DT&E. However, there were some incidents during the ground testing portion when Patriot did not properly transmit messages, had degraded track triangulation between batteries, was unable to isolate faults and had to be rebooted, selected a launcher with no available missiles, and selected less preferred missiles against threats (e.g., a GEM against a long-range tactical ballistic missile or a PAC-3 missile against a threat aircraft). The Patriot system did not meet its reliability requirements during this test.
- During PDB-7 flight test P7-4, Patriot demonstrated the capability to search, detect, track, engage, and intercept a tactical ballistic missile target with PAC-3 missiles in a ripple engagement. There were some discrepancies between the performance of the second PAC-3 missile during its initial turn and pre-flight simulations. The causes of these discrepancies are still under investigation. One of the two non-firing Patriot batteries did not collect data during the P7-4 flight test. The affected non-firing battery restarted the data collection system multiple times in an effort to fix the problem, but it was not resolved before the engagement.
- During PDB-7 flight test P7-3, Patriot demonstrated the capability to search, detect, track, engage, and intercept a tactical ballistic missile target with GEM missiles in a ripple engagement.
- During PDB-7 flight test P7-2, Patriot demonstrated the capability to detect, engage, and intercept short-range ballistic missile targets with GEM-T missiles. Patriot conducted the second engagement in the presence of the debris cloud caused by the first intercept.
- During PDB-7 flight test P7-1, Patriot demonstrated the capability to detect, engage, and intercept cruise missile targets in clutter with GEM-T and GEM-C missiles.
- During IFC-1, Patriot demonstrated the capability to use the Joint Land Attack Cruise Missile Defense Elevated Netted Sensor System cuing data to engage a cruise missile with a PAC-3 missile. The PAC-3 missile intercepted the target.
- During the Launcher/Missile Characterization Test, an MSE missile was launched at a 70-degree angle, performed an out-of-plane maneuver, and followed the predicted flight path to the simulated target, which was 120 degrees off the launch axis. All test objectives were met.
- Patriot intercepted four of five tactical ballistic missile targets and three of three air-breathing threat/cruise missile targets during five FMS flight tests.
  - The original target in the FMS G-3 missile flight test was to be engaged with only one GEM-T missile, but the GEM-T missile had a launch sequence failure and there was not an active back-up missile that could launch in its place. After this failure, a back-up tactical ballistic missile target and back-up GEM-T missile were activated. The back-up GEM-T missile engaged and intercepted the back-up tactical ballistic missile target.
  - The FMS G-6/G-7 missile flight test was a GEM-T ripple engagement of another tactical ballistic missile target in the debris caused by the G-3 intercept. The first GEM-T had a launch sequence failure. However, there was a live back-up missile for this engagement so two GEM-T missiles were launched, the first of which intercepted the target.
- During FTI-01, Patriot demonstrated the capability to detect, track, engage, intercept, and kill both a tactical ballistic missile target and a cruise missile target with PAC-3 missiles. There was a Patriot radar fault between the cruise missile and ballistic missile engagements, but the system recovered and was able to conduct a nominal engagement. The root cause of the radar fault is under investigation. All PAC-3 missile subsystems performed as expected. The Patriot engagements were conducted in the debris field from the THAAD intercept and Patriot debris mitigation was nominal. Aegis BMD failed to intercept its ballistic missile target during FTI-01. The Missile Defense Agency did not set up the flight test so Patriot could intercept targets that Aegis or THAAD missed, although DOT&E had recommended this be a feature of BMDS flight testing (previous recommendation #6 below).
- Continuing obstacles to adequate T&E of the Patriot system include:
  - Limitations to the lethality information available for aircraft, cruise missile, and air-to-surface missile threats used to assess end-to-end system effectiveness.
  - The lack of a robust interoperability event during PDB-7 testing.
  - The lack of a robust Force Development Experiment, preventing the Army from thoroughly examining tactical standard operating procedures prior to developing Patriot PDB-7 tactics, techniques, and procedures. As a result, the engagement procedures used during the PDB-7 LUT against some threats may have led to decreased system performance.

Recommendations

- Status of Previous Recommendations. The Army satisfactorily addressed 10 of the previous 18 open recommendations. The Army should still address the following recommendations:
  1. Conduct Patriot testing during joint and coalition exercises.
  2. Upgrade the Patriot HWIL systems to model electronic countermeasures and identification friend-or-foe systems.
  3. Conduct a Patriot flight test against an anti-radiation missile target to validate models and simulations.
  4. Review the risks of not conducting all flight tests against ballistic missile targets using two interceptors.
  5. Improve Patriot training.
  6. Have Patriot participate with live interceptors in THAAD flight testing.
  7. Conduct all operational testing regression tests with representative Soldier operators.
  8. Conduct a robust Force Development Experiment prior to the PDB-8 IOT&E to ensure that tactics, techniques, and procedures are adequate to support a successful operational test.
- FY12 Recommendations. In addition to addressing the above recommendations, the Army should:
  1. Collect reliability data on Patriot systems in the field, including total operating hours and numbers of critical mission failures for each Patriot battery major end item, so that the Mean Time Between Critical Mission Failure can be calculated.
  2. Ensure that test units for future Patriot operational tests have operationally representative distributions in Soldier proficiency by limiting transfers of experienced personnel to other units before the end of testing.
  3. Conduct future operational flight tests with unannounced target launches within extended launch windows to improve operational realism.

Precision Guidance Kit (PGK)

Executive Summary

- In January 2011, the Army restructured the Precision Guidance Kit (PGK) Increment 1 program to address any necessary schedule changes due to reliability test failures that occurred in August 2010.
- Baseline reliability testing in August 2011 demonstrated that the contractor and program manager resolved the system's main reliability problems identified in 2010.
- In March 2012, the program received approval to accelerate fielding to Operation Enduring Freedom in FY13. The program currently has two tracks – the restructured baseline Program of Record and the Urgent Materiel Release (UMR).
- The program is currently undergoing government qualification testing and is revising the PGK Test and Evaluation Master Plan to support a Milestone C decision.
- In late October 2012, as part of the UMR program, the Army conducted an Early User Assessment that provided Soldiers their first opportunity to fire the PGK. The howitzer crew performed their tasks successfully in six operationally realistic end-to-end missions firing a total of 20 PGKs from an M777A2 howitzer. Preliminary data indicate that the PGK's accuracy is well within requirements.
- The PGK experienced two reliability failures. The program is investigating potential modifications to the GPS antenna and the ballistic parameters used to compute the firing mission when firing an M549A1 projectile.

System

- The PGK is a combined fuze and GPS guidance kit that improves the ballistic accuracy of the current stockpile of field artillery projectiles.
- The Army plans to develop PGK in two increments:
  - Increment 1. Provide 155 mm High-Explosive projectiles (M795 and M549A1) with 50 meter Circular Error Probable (CEP).
  - Increment 2. Improve delivery accuracy to 30 meters (threshold) and 20 meters (objective) CEP, as well as add anti-jam capability as a threshold requirement.
- The PGK will operate with existing and developmental artillery systems that have digital fire control systems and inductive fuze setters such as the M777A2 Lightweight Towed Howitzer and the M109A6 Paladin Self-Propelled Howitzer.

Mission

Field Artillery units will use PGK to provide indirect fire support with 30 – 50 meters accuracy to combat maneuver units in all types of weather and terrain. Artillery units will use PGK to achieve comparable effects of conventionally fuzed projectiles using fewer rounds and thus reducing collateral damage.

Major Contractor

Alliant-Techsystems Advanced Weapons Division – Plymouth, Minnesota

Activity

- In January 2011, the Army restructured the PGK Increment 1 program to address schedule changes due to the reliability test failures that occurred in August 2010. The restructured program features a Milestone C decision in 2QFY13, an Initial Operational Test (IOT) in 1QFY14, a Full-Rate Production decision in 2QFY14, and an Initial Operational Capability in 3QFY14.
- The PGK Increment 1 has three Milestone C entrance criteria: interoperability, reliability, and accuracy. The program successfully demonstrated interoperability during DOT&E-approved testing in 2009.
- In August 2011, the Army tested a modified PGK to address known failure modes in order to demonstrate satisfactory

baseline reliability to support entrance into the next phase of Engineering and Manufacturing Development.

- In March 2012, the program received approval to accelerate fielding to Operation Enduring Freedom in FY13. Thus, the program currently has two tracks – the baseline Program of Record and the UMR.
- The program is currently undergoing government qualification testing, which includes Sequential Environmental Tests for safety and performance.
- The program is revising the PGK Test and Evaluation Master Plan to support a Milestone C decision in 2QFY13. Following Milestone C, the program intends to begin the manufacturing of fuzes for the IOT and the validation of the production line to support the Full-Rate Production decision. The program plans to conduct an IOT in 1QFY14 at Yuma Proving Ground, Arizona.
- In late October 2012, as part of the UMR program, the Army conducted an Early User Assessment that provided Soldiers their first opportunity to fire the PGK. The howitzer crew performed their tasks successfully in six operationally realistic end-to-end missions firing a total of 20 PGKs from an M777A2 howitzer. These firings provided both accuracy and reliability as input to the UMR decision planned for 2QFY13.

Assessment

- In August 2011, the Baseline Reliability testing of 48 fuzes to support entrance into the next phase of Engineering and Manufacturing Development demonstrated 84 percent reliability with 80 percent confidence, exceeding the required 83 percent with 80 percent confidence. This was the target reliability for a successful program and approval of an accelerated fielding effort.
- This reliability estimate is on the reliability growth curve for the program leading to the Capability Production Document requirement of 92 percent by Initial Operational Capability. However, in the July 2012 Sequential Environmental Test – Safety, three rounds fell significantly short of the target. This indicates a possible new failure mode. These failures are currently undergoing failure analysis. The Army will determine the effect of these failures on the program schedule upon completion of the failure analysis.
- The program is meeting accuracy requirements for the M795 and the M549A1 155 mm high-explosive projectiles at low- and mid-firing angles. The program has focused considerable resources and is making some progress in enhancing the PGK accuracy at higher firing angles.
- Results from the operational Early User Assessment of 20 fuzes in October 2012 indicate that the PGK demonstrated an 85 percent reliability with a lower 80 percent confidence bound of 74 percent. Two of the three failures in the small sample replicated a known failure mode with a planned corrective action in the Program of Record track but not in the initial UMR lots. Preliminary accuracy data indicate that overall, the PGK's accuracy met the threshold requirement of 50 meters CEP, demonstrating a 32-meter CEP although there was considerable variability in the errors – ranging from 9 meters to 131 meters. The program is investigating modifications to the GPS antenna and the ballistic parameters used to compute the firing mission when firing an M549A1 projectile. A change to the digital fire control software is in progress, which should be implemented with the upcoming UMR fielding.

Recommendations

- Status of Previous Recommendations. The Army has satisfactorily addressed all previous recommendations.
- FY12 Recommendations. The Army should:
  1. Continue to closely monitor developmental testing to ensure that the identified corrective actions for the known deficiencies are satisfactory and do not adversely affect other performance parameters prior to Milestone C.
  2. Determine the root cause of the rounds that fell short of the target and implement corrective action prior to Milestone C.
  3. Determine the causes of the substantial variance in accuracy observed in the Early User Assessment.

Q-53 Counterfire Target Acquisition Radar System

Executive Summary

- In February 2012, the Army selected Lockheed Martin as the primary contractor for the Q-53 Program of Record. The Army plans to buy 136 Q-53 radars as part of the Program of Record.
- The Army contracted with Lockheed Martin to build 38 Quick Reaction Capability (QRC) radars to support an Urgent Materiel Release. The QRC production buy was completed in March 2012. Five QRC systems are operating in Afghanistan.
- The Army completed the first reliability test of the Program of Record radar. The radar's system abort rate was better than the rate observed in the system demonstration prior to the February 2012 Milestone C update. However, the demonstrated reliability rate is below the predicted rates needed to reach reliability requirements by the IOT&E.

System

- The Army changed the designation of the Enhanced AN/TPQ-36 (EQ-36) radar to the AN/TPQ-53 (Q-53) radar in September 2011.
- The Q-53 is a mobile radar system designed to detect, classify, and track projectiles fired from mortar, artillery, and rocket systems using a 90-degree or continuous 360-degree sector search.
- The radar provides target location of threat indirect fire systems with sufficient accuracy for effective counterfire.
- The Q-53 is designed to operate with the Counter – Rocket, Artillery, Missile (CRAM) system and the future Indirect Fire Protection Capability System.
- The Army intends to field the Q-53 radar to the sensor platoons in Brigade Combat Teams and Fire Brigades to replace the legacy AN/TPQ-36 and AN/TPQ-37 Firefinder Radars.
- The Q-53 is operated by a crew of four Soldiers and transportable by C-17 aircraft, with battlefield mobility provided by two Family of Medium Tactical Vehicle trucks.
- The Army contracted with Lockheed Martin Missile Systems and Sensors to develop and field 38 QRC radars to support an Urgent Material Release. Fielding began in 2010 with five systems operating in Afghanistan.
- The Army intends to produce 136 Program of Record Q-53 radars.

Mission

Field Artillery units protect friendly forces by employing the Q-53 radar to determine timely and accurate location of threat rocket, artillery, and mortar systems for defeat with counterfire engagements. Air Defense Artillery units will use the Q-53 radar integrated into the CRAM and Indirect Fire Protection Capability System to warn friendly forces and to engage incoming threat indirect fires.

Major Contractor

Lockheed Martin Missile Systems and Sensors – Syracuse, New York

Activity

- The Army conducted a Milestone C update on February 27, 2012. The Army selected Lockheed Martin as the primary contractor.
- The Army purchased 33 systems as part of the Milestone C update decision.
- The Army intends to purchase an additional 18 systems after the Limited User Test (LUT) scheduled for October 22 through November 8, 2012, and the remaining 85 systems at the 4QFY14 Full-Rate Production decision following the IOT&E in 1QFY14.
- The Army completed the first Program of Record reliability and performance tests at Yuma Proving Ground, Arizona, from May 15 through August 17, 2012. The contractor-operated radars completed 1,662 test hours. The two radars operated continuously in 72-hour cycles and made moves representative of the distances and terrain expected in an operational environment.
- Environmental chamber testing began at White Sands Missile Range, New Mexico, in August 2012. It will be completed by the end of 2012.

Assessment

- Based on developmental testing at Yuma Proving Ground, the radar's reliability has improved since the system demonstration, but is below the growth projections needed to reach the reliability requirement at IOT&E.
- During the system demonstration in 2011, the radar averaged 1 system abort every 30 hours. During 2012 developmental testing, the Program Office made three significant configuration changes to address system aborts.
  - During the first 2 configuration changes, the radars averaged 1 system abort every 103 hours and 1 system abort every 238 hours, respectively.
  - During limited testing of the final configuration (298 test hours), the radars averaged a system abort every 75 hours.
- To reach the reliability threshold, the Program Office expected the radar to average 1 system abort every 257 hours. The Army determined two of the four system aborts during testing of the final configuration were due to problems with the user manual and training deficiencies, unrelated to the final configuration. The user manual and training will be updated prior to the LUT. The remaining two system aborts were software related and will not be addressed prior to the LUT.
- The radar met performance requirements during limited developmental testing in FY12. More extensive performance testing is planned for the LUT in October and November 2012.

Recommendations

- Status of Previous Recommendations. The Army satisfactorily addressed all of the FY11 recommendations.
- FY12 Recommendations. The Army should:
  1. Conduct future developmental reliability tests with trained civilian crews and limited contractor involvement.
  2. Continue dedicated reliability testing focusing on system aborts.

Spider XM-7 Network Command Munition

Executive Summary

- The Army uses Spider instead of persistent landmines to comply with the requirements of the 2004 National Landmine Policy.
- The Army fielded Spider Low-Rate Initial Production (LRIP) systems to deployed and non-deployed units during 2012.
- At the request of the Army, DOT&E published a Beyond Low-Rate Initial Production (BLRIP) report in February 2012 to support a Full-Rate Production (FRP) decision in 2012. Following publication of this report, the Army postponed the Spider FRP decision until 3QFY13.
- The Army continued corrective actions to address Spider deficiencies with system reliability, complexity, and training reported in the February 2012 DOT&E Spider BLRIP Report.
- DOT&E will report on the operational effectiveness, suitability, and survivability of the Spider system early in 2013 following a third FOT&E. Based on analysis conducted to date, Spider has demonstrated effectiveness and lethality with poorly demonstrated suitability.

System

- The Army intends to use Spider as a landmine alternative to satisfy the anti-personnel munition requirements outlined in the 2004 National Landmine Policy that directs the DoD to:
  - End use of persistent landmines after 2010
  - Incorporate self-destructing and self-deactivating technologies in alternatives to current persistent landmines
- A Spider munition field includes:
  - Up to 63 Munition Control Units, each housing up to 6 miniature grenade launchers or munition adapter modules for remote electrical and non-electrical firing capabilities
  - A remote control station, used by the operator to maintain "man-in-the-loop" control of all munitions in a field
  - A communications relay device known as a "repeater" for use in difficult terrain or at extended ranges
- Spider incorporates self-destructing and self-deactivating technologies to reduce residual risks to non-combatants.

Mission

Maneuver or engineer units employ Spider to establish a force protection obstacle or as a stand-alone force protection system in all environments and in all terrains in order to accomplish the following missions:

- Protect the Force
- Shape the Battlefield
- Provide Early Warning
- Delay and Attrite Enemy Forces

Major Contractors

- Command and Control hardware and software: Textron Defense Systems – Wilmington, Massachusetts
- Munition Control Unit and Miniature Grenade Launcher: Alliant-Techsystems, Advanced Weapons Division – Plymouth, Minnesota

Activity

- The Army continued fielding Spider LRIP systems to deployed and non-deployed units. Home Station, Combat Training Center, and in-theater training were provided by the materiel and combat developers as part of the fielding package. In January 2012, the Army Milestone Decision Authority approved the production of additional LRIP systems to support continued fielding prior to an FRP decision.
- Based on demonstrated performance in the May 2010 Spider FOT&E and the June 2011 Spider Limited User Test, the Army requested DOT&E publish a BLRIP report in February 2012. Following publication of the report, the Army postponed the Spider FRP decision until 3QFY13.
- The Army continued corrective actions to address Spider deficiencies with system reliability, complexity, and training reported in the February 2012 DOT&E Spider BLRIP Report.
- The Army and DOT&E finalized planning for the third FOT&E in October 2012 to demonstrate corrective actions in an operationally realistic environment.

- In October 2012, DOT&E approved an updated Test and Evaluation Master Plan. The update addressed the scope and execution of a comprehensive FOT&E to demonstrate Spider operational effectiveness and suitability in support of an Army FRP decision.

Assessment

- The Army conducted the Spider XM7 Limited User Test in accordance with the DOT&E-approved test plan in June 2011 at White Sands Missile Range, New Mexico.
- DOT&E intends to publish an updated evaluation on Spider XM7 early in FY13 based on the October 2012 FOT&E.
- DOT&E made the following assessment based on the BLRIP report in February 2012:
  - Spider provides the following enhanced capabilities not previously available with anti-personnel land munition systems:
    - "Man-in-the-loop" positive control of both lethal and non-lethal munitions
    - Remote electrical and non-electrical firing capabilities for munitions and demolitions to a range of 4 kilometers
    - Capability to fire a single munition or multiple munitions simultaneously
    - Capability to collect situational awareness information through tripline activation by threat personnel
  - Spider has demonstrated effectiveness and lethality.
    - A properly trained unit can successfully emplace and operate a Spider munition field in order to provide doctrinal protective obstacle effects – warn of threat activity and mitigate or prevent threat actions.
    - Units employing Spider can utilize both non-lethal and lethal munitions to achieve desired force escalation capabilities.
  - Spider has demonstrated poor suitability.
    - Spider is more complex than its predecessor system and requires Soldiers to receive extensive initial and sustainment training to maintain proficiency.
    - The Spider system's Munition Control Unit has not demonstrated the required reliability in a comprehensive operationally realistic environment.
    - Extensive battery management requirements and increased unit transportation requirements create a logistics planning challenge for units employing Spider.
- The Spider program demonstrated in contractor and government testing corrective actions to address reliability, complexity, and training deficiencies reported in the February 2012 DOT&E Spider BLRIP Report. These corrective actions are ready for further testing in an operationally realistic environment.

Recommendations

- Status of Previous Recommendations. The Army initiated actions to address the previous recommendations.
- FY12 Recommendation.
  1. The Army should closely monitor the results of the October 2012 FOT&E and be prepared to address shortcomings and deficiencies as necessary to support a 3QFY13 FRP decision.

Stryker Mobile Gun System (MGS)

Executive Summary

- During the December 2010 Stryker Double-V Hull (DVH) Configuration Steering Board, the Army decided not to pursue full-rate production for the flat-bottom Stryker Mobile Gun System (MGS).
- Developmental tests have failed to replicate the coaxial machine gun deficiency in which brass and links falling into the ammunition storage box cause the low ammunition sensor to fail to activate. This deficiency was noted in the August 2011 Engineering Change Order Block III validation gunnery and has been noted by MGS crews returning from Afghanistan and during their training gunneries.
- Live fire testing indicates performance deficiencies in the protection provided by the Stryker Reactive Armor Tiles (SRAT) II configuration for MGS. The details are classified.

System

- The Stryker Family of Vehicles consists of two variants on a common vehicle platform: Infantry Carrier Vehicle and the MGS. There are eight configurations of the Infantry Carrier Vehicle variant.
- The MGS mission equipment includes the following:
  - The system integrates the Driver's Vision Enhancer and Command, Control, Communications, Computers, Intelligence, Surveillance, and Reconnaissance components as government-furnished equipment.
  - The MGS provides the three-man crew with varying levels of protection against small-arms, fragmenting artillery, mines, and rocket-propelled grenades (RPGs). Add-on slat armor (high hard steel arranged in a spaced array) provides RPG protection.
- The MGS mission equipment includes the following:
  - M68A2 105 mm cannon system with an ammunition handling system
  - Coaxial 7.62 mm machine gun and a secondary M2HB, .50-caliber machine gun
  - Full solution fire control system with two-axis stabilization
  - Low-profile turret meant to provide survivability against specified threat munitions

Mission

- The Stryker Brigade Combat Team uses the MGS to create openings in walls, destroy bunkers and machine gun nests, and defeat sniper positions and light armor threats. The primary weapon systems are designed to be effective against a range of threats up to T-62 tanks.
- The MGS operates as a three-vehicle platoon organic to the Stryker infantry company or as a single vehicle in support of a Stryker infantry platoon.

Major Contractor

General Dynamics Land Systems – Sterling Heights, Michigan

Activity

- During the December 2010 Stryker DVH Configuration Steering Board, the Army decided not to pursue full-rate production for the Stryker flat-bottom MGS. The Army determined it could not integrate the DVH design onto the MGS platform without the Stryker Modernization program to resolve weight and power shortfalls.
- A total of 142 MGSs have been produced and fielded. Three MGSs have been total losses as a result of battle damage so the current fleet has 139.
- Testing in the August 2011 Engineering Change Order Block III validation gunnery confirmed the low ammunition sensor deficiency as part of the larger deficiency, inadequate ready load for the 7.62 coaxial machine gun. This is 1 of the 5 remaining deficiencies of 23 identified in the July 2008 Acquisition Decision Memorandum.
- During 2012, the contractor was not able to replicate the coaxial machine gun low ammunition sensor deficiency in

which brass and links falling into the ammunition storage box inadvertently triggered the low ammunition sensor.

- The Army executed multiple components of the LFT&E program for the MGS with SRAT II, including tests to characterize the protection provided by the add-on armor and full-up system-level testing to characterize SRAT II integration effects on the MGS mission equipment.
- The Army, in coordination with DOT&E, submitted the seventh report to Congress in December 2011, updating the status of actions taken by the Army to correct or mitigate all Stryker MGS deficiencies, as directed in Section 115 of the FY09 Duncan Hunter National Defense Authorization Act. The Army will issue their next report when the remaining five deficiencies are corrected.

Assessment

- The Army has yet to correct the coaxial machine gun low ammunition sensor deficiency via material fix or crew workaround. The program manager has designed a chute modification with follow-on testing to take place in December.
- Live fire testing indicates performance deficiencies in the protection provided by the SRAT II configuration for MGS. The details are classified.
- In the 2007 Beyond Low-Rate Initial Production report, DOT&E assessed the MGS as not operationally effective when operating in a degraded capacity. DOT&E assessed that the gun pod can be easily disabled, causing the MGS to operate in a degraded capacity, thereby making the MGS not operationally effective. Lack of adequate gun pod protection makes the MGS vulnerable to widely proliferated threats including RPGs, which increases the likelihood of the MGS operating in a degraded capacity. The Army has no plans to improve gun pod protection.
- The C-130 Transportability Key Performance Parameter is a design constraint that limits MGS capabilities. Because of size and weight constraints for transporting equipment on the C-130, there is a limitation on the size and weight of the MGS. This limit results in several survivability deficiencies, including protection of the Commander's Weapon Station, protection of 105 mm ammunition, gun pod protection, and hydraulic circuit separation. If this program moves forward, a Stryker modernization program will have the opportunity to address these deficiencies.

Recommendations

- Status of Previous Recommendations. The Army addressed the one new recommendation from FY11.
- FY12 Recommendations. As part of our coordination with the Army, as directed in Section 115 of the FY09 National Defense Authorization Act, DOT&E recommended that the Army:
  1. Increase gun pod protection.
  2. Provide a close out report to Congress when the RPG protection deficiency and the coaxial low ammunition sensor deficiency is corrected.

Stryker Double-V Hull (DVH)


XM1256 Infantry Carrier Vehicle


XM1257 Engineer Squad Vehicle


XM1255 Commanders Vehicle


XM1256 Infantry Carrier Vehicle - Scout


XM1251 Fire Support Vehicle


XM1254 Anti-Tank Guided Missile Vehicle


XM1252 Mortar Carrier Vehicle


XM1253 Medical Evacuation Vehicle

Executive Summary

- The Army rapidly developed, tested, and fielded the Stryker Double-V Hull (DVH) in response to needs from commanders in Operation Enduring Freedom (OEF) regarding Stryker force protection/survivability shortfalls against underbody IEDs and blast threats. Testing and analysis confirm that the Stryker DVH configurations improve Stryker vehicle protection against IEDs; the details are classified.
- All configurations of the Stryker DVH are operationally effective for deployment into Afghanistan.
- All configurations of the Stryker DVH are operationally suitable.
- DOT&E published six classified reports on FY12 activity for the following variants: the Stryker DVH Commander’s Vehicle (CVV), Infantry Carrier Vehicle – Scout (ICVV-S), Mortar Carrier Vehicle (MCVV), Medical Evacuation Vehicle (MEVV), Engineer Squad Vehicle (ESVV), and Anti-Tank Guided Missile Vehicle (ATVV).
- The Army Test and Evaluation Command (ATEC) continues to develop the System Evaluation Plan in support of testing for Stryker DVH worldwide fielding.

System

- The Stryker DVH Infantry Carrier Vehicle (ICVV) is the base variant for seven additional DVH configurations:
  - Anti-Tank Guided Missile Vehicle (ATVV)
  - Commander’s Vehicle (CVV)
  - Engineer Squad Vehicle (ESVV)
  - Fire Support Vehicle (FSVV)
  - Mortar Carrier Vehicle (MCVV)
  - Medical Evacuation Vehicle (MEVV)
  - ICVV-Scout (ICVV-S)
- The ICVV-S is a new configuration to permit internal stowage of the Long-Range Advance Scout Surveillance System.
- The DVH configuration consists of a redesigned lower hull, energy attenuating seats, and an up-armored driver station. An upgraded suspension and driveline are incorporated because of the additional weight.
- At this time, the Army does not plan to purchase Stryker DVH versions of the Stryker Reconnaissance Vehicle; Mobile Gun System; or the Nuclear, Biological, Chemical Reconnaissance Vehicle.

Mission

- Combatant Commanders employ a DVH-equipped Stryker Brigade Combat Team (SBCT) as a decisive action combat force that conducts operations (offensive, defensive, stability, and defense support of civil authorities) against conventional or unconventional enemy forces in all types of terrain and climate conditions. In addition, it operates across the range of military operations (major operations and campaigns, crisis response and limited contingency operations, military engagement, security cooperation, and deterrence).
- The DVH-equipped SBCT has the same mission profile as a non DVH-equipped SBCT. The Army intends to use the DVH as Theater Provided Equipment in Afghanistan, and provide the Army with a long-term worldwide capability to simultaneously deploy SBCTs into a non-permissive environment.
- The Army intends for the Stryker DVH to provide improved survivability against IEDs and blast threats, beyond the protection provided by current flat-bottom Stryker vehicles with OEF kits.

Major Contractor

General Dynamics Land Systems – Sterling Heights, Michigan

Activity

- The Army executed all live fire and operational testing in accordance with DOT&E-approved test plans.
- The Army executed multiple series of full-up system-level live fire events against the following DVH versions: ESVV, CVV, MCVV, MEVV, ATVV, and ICVV-S. The purpose of the follow-on DVH LFT&E program was to compare each DVH configuration's IED protection to existing OEF-kitted Stryker vehicles, as well as to identify any configuration-unique vulnerabilities to underbody IED and blast threats.
- ATEC completed developmental, operational, and live fire testing of the following Stryker DVH variants: ICVV-S, CVV, FSVV, MCVV, MEVV, and ATVV through 3QFY12 to characterize any degradation to reliability, availability, maintainability, and cross-country mobility, and compare DVH performance to the Strykers currently used in OEF. ATEC conducted operational testing of the MCVV at Yuma Proving Ground, Arizona, and integrated testing of the MEVV at Aberdeen Proving Ground, Maryland.
- DOT&E published classified reports on the CVV, ICVV-S, MCVV, MEVV, ESVV, and ATVV variants on FY12 activity.
- The Army corrected suitability shortfalls with the driver's station identified during the initial ICVV operational test through an initiative called the Driver's Station Enhancement II (DSE II). The Army executed suitability and survivability testing of the DSE II March to July 2012 at Fort Lewis, Washington; Aberdeen Proving Ground, Maryland; and Yuma Proving Ground, Arizona.
- ATEC continues to develop the System Evaluation Plan to support testing measures for worldwide use of Stryker DVH.

Assessment

- Stryker DVH systems were rapidly developed, tested, and fielded in response to needs from commanders in OEF. Testing and analysis confirm that DVH systems improve Stryker vehicle protection against IEDs. The details can be found in the classified DOT&E LFT&E report on the CVV (January 2012) and Operational Assessment/LFT&E reports for ICVV-S (January 2012), MCVV (May 2012), and MEVV (July 2012).
- All configurations of the Stryker DVH are operationally effective for deployment into Afghanistan. There were no significant differences between the Strykers currently used in OEF and DVH Strykers regarding mobility and the ability of units equipped with the two types of vehicles to accomplish the mission.
- All configurations of the Stryker DVH are operationally suitable to include the driver's station. The Stryker DVH demonstrated better reliability and maintainability than the OEF variant.

Recommendations

- Status of Previous Recommendations. The Army addressed the previous recommendations.
- FY12 Recommendations. None.

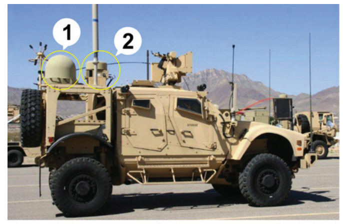
Warfighter Information Network – Tactical (WIN-T)

Executive Summary

- In 2011, the Army conducted a Warfighter Information Network – Tactical (WIN-T) Increment 2 developmental test that assessed a network of more than 70 WIN-T Increment 2 communications nodes. In benign developmental test conditions, WIN-T Increment 2 met its performance requirements, but did not meet its Army-defined reliability requirements.
- In May 2012, the Army conducted a WIN-T Increment 2 IOT&E as a part of the Network Integration Evaluation (NIE) 12.2. The Soldier Network Extension (SNE), Tactical Relay-Tower (TR-T), and High-Band Networking Waveform (HNW) were not effective. All other configuration items and the Net-Centric Waveform (NCW) were effective.
- DOT&E provided details of the IOT&E test results in the WIN-T Increment 2 Beyond Low-Rate Initial Production (BLRIP) Report issued on September 25, 2012.
- WIN-T Increment 2 is not suitable due to poor reliability and maintainability and not survivable due to deficiencies noted in the classified annex to the DOT&E BLRIP report.
- In September 2012, the Defense Acquisition Executive (DAE) authorized the Army to procure an additional 538 WIN-T Increment 2 communication nodes. The DAE directed the Army to conduct an FOT&E to demonstrate improvement of the SNE and HNW, and to provide evidence that each WIN-T Increment 2 configuration item is on track to meet reliability and maintainability requirements. The DAE directed the Army to provide an updated growth plan with growth curves to achieve reliability and maintainability requirements for each WIN-T Increment 2 configuration item.
- The program plans to conduct an FOT&E on the system during NIE 13.2 in May 2013.

System

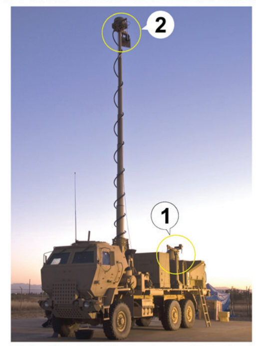
- The Army designed the WIN-T as a three-tiered communications architecture (space, terrestrial, and airborne) to serve as the Army's high-speed and high-capacity tactical communications network.
- The Army intends WIN-T to provide reliable, secure, and seamless communications for units operating at theater level and below.
- The WIN-T program consists of four increments.
  - Increment 1: "Networking At-the-Halt" enables the exchange of voice, video, data, and imagery throughout the tactical battlefield using a Ku- and Ka-satellite-based network. The Army has fielded WIN-T Increment 1 to its operational forces.



Point of Presence

Soldier Network Extension

1 - Net-Centric Waveform Antenna
2 - High-Band Networking Waveform Antenna



Tactical Comms Node

  - Increment 2: "Initial Networking On-the-Move" provides command and control on-the-move down to the company level for maneuver brigades and implements an improved network security architecture. WIN-T Increment 2 supports on-the-move communications for commanders with the addition of the Point-of-Presence (PoP) and the SNE and provides a mobile network infrastructure with the Tactical Communications Node (TCN).
  - Increment 3: "Full Networking On-the-Move" provides full mobility command and control for all Army field commanders, from theater to company level. Network reliability and robustness are enhanced with the addition of the air tier transport layer, which consists of networked airborne communications relays.
  - Increment 4: "Protected Satellite Communications On-the-Move" includes access to the next generation of protected communications satellites while retaining all previous on-the-move capabilities.

Mission

Commanders at theater level and below will use WIN-T to:

- Integrate satellite-based communications capabilities into an everything-over-Internet Protocol network to provide connectivity, while stationary, across an extended, non-linear battlefield and at remote locations (Increment 1).

- Provide division and below maneuver commanders with mobile communications capabilities to support initial command and control on-the-move (Increment 2).
- Provide all maneuver commanders with mobile communications capabilities to support full command and control on-the-move, including the airborne relay and protected satellite communications (Increments 3 and 4).

Major Contractor

General Dynamics, C4 Systems – Taunton, Massachusetts

Activity

- In 2011, the Army conducted a developmental test that assessed a WIN-T Increment 2 network containing more than 70 communications nodes. The Army conducted the test at Aberdeen Proving Ground, Maryland, and the contractor's facility in Taunton, Massachusetts.
- In January 2012, the Army conducted cold weather developmental testing at the Cold Weather Natural Environmental Testing, Fort Greeley, Alaska.
- In February 2012, the Army approved a revised requirement that lowered WIN-T Increment 2's reliability requirement by 30 – 60 percent based upon an updated operational mission summary/mission profile.
- In May 2012, the Army Test and Evaluation Command (ATEC) conducted the WIN-T Increment 2 IOT&E using the following units employed under operationally realistic mission scenarios.
  - 2nd Brigade, 1st Armored Division, Fort Bliss, Texas, and White Sands Missile Range, New Mexico
  - 101st Airborne Division, Fort Campbell, Kentucky
  - Sustainment Brigade, Fort Riley, Kansas
  - Network Service Center – Training, Fort Gordon, Georgia
- The WIN-T Increment 2 IOT&E included a fully equipped brigade and division headquarters dispersed over a wide geographic area to assess WIN-T Increment 2's capability to support the unit's at-the-halt and on-the-move mission in desert, forest, and urban terrain. ATEC conducted IOT&E in accordance with a DOT&E-approved Test and Evaluation Master Plan and test plan.
- On September 2012, the DAE chaired the WIN-T Increment 2 Defense Acquisition Board (DAB) to consider whether to approve the system for full-rate production and published an Acquisition Decision Memorandum (ADM) detailing the results. DOT&E provided a BLRIP report to support the DAB.

Assessment

- During the 2011 developmental test, the Army's developmental test efforts assessed that WIN-T Increment 2 met its performance requirements under benign conditions. WIN-T Increment 2 did not meet its reliability requirements and did not demonstrate planned reliability growth.
- During the Army's January 2012 cold weather testing, WIN-T Increment 2 met its cold weather requirements. During testing, the PoP demonstrated reduced bandwidth throughput (up to 10 percent) when the configuration item switched between terrestrial HNW and satellite NCW.
- DOT&E assessed the following WIN-T Increment 2 items as effective based upon performance demonstrated during IOT&E:
  - **TCN.** The TCN improved mission performance by sustaining a mission command network, and providing voice and data access to the network while on-the-move.
  - **PoP.** The PoP provided voice and data support for commanders while on-the-move and at-the-halt.
  - **Network Operations and Security Center (NOSC).** The NOSC supported the unit's network management mission at division and brigade, but needed additional Soldiers and tools at battalion and company.
  - **Colorless Core.** The Colorless Core supported multiple security levels and improved bandwidth allocation.
  - **NCW.** Given sufficient satellite bandwidth, the NCW connected TCNs and PoPs to the network and provided sufficient data flow while at-the-halt and on-the-move.
  - **Satellite Tactical Terminal + (STT+).** The STT+ demonstrated simultaneous connections of its satellite waveforms in support of the unit's mission.
  - **Vehicle Wireless Package (VWP).** The VWP was useful at the brigade and division levels, but should be installed in different vehicles at battalion level to better support command post movements.
  - **Joint Gateway Node (JGN).** The JGN allows WIN-T to connect to a variety of external networks.
  - **Modular Communications Node – Basic (MCN-B).** The MCN-B allowed the unit to extend subscriber services from an adjacent TCN.
- DOT&E assessed the following WIN-T Increment 2 items as not effective based upon performance demonstrated during the IOT&E:
  - **SNE.** The SNE did not support commanders while on-the-move but served as an alternate communications means while at-the-halt.
  - **HNW.** The HNW terrestrial line-of-sight waveform demonstrated poor transmission range in vegetation and routing problems that decreased the WIN-T Increment 2 network's performance.
  - **TR-T.** The single TR-T employed at brigade was not able to keep the HNW network from fragmenting when the unit dispersed.

- DOT&E assessed the WIN-T Increment 2 as not suitable due to poor reliability and poor maintainability:
  - The VWP and MCN-B met their reliability requirements. The TCN, PoP, SNE, TR-T, and NOSC did not meet their reliability requirements. The WIN-T Increment 2 on-the-move platforms (TCN, PoP, and SNE) reliability estimates demonstrated during IOT&E are less than one third of the Army requirement.
  - The VWP and JGN met their maintainability requirements, while the remaining configuration items did not meet the Mean Time to Repair requirement. The IOT&E hosted twice the number of Field Service Representatives to perform maintenance (relative to the Army's support plan). Even with increased Field Service Representatives present at IOT&E, repair times for half of the configuration items took two to four times longer than the Army's requirement.
- As a result of IOT&E, DOT&E assessed WIN-T Increment 2 as not survivable due to significant Information Assurance vulnerabilities that would degrade a unit's ability to succeed in combat. These vulnerabilities are discussed in a classified annex to the DOT&E BLRIP report.
- On September 26, 2012, the DAE signed an ADM that:
  - Authorized the Army to procure an additional 538 WIN-T Increment 2 communication nodes as a second Low-Rate Initial Production.
  - Directed the Army to conduct an FOT&E to demonstrate operational effectiveness and suitability of the SNE and HNW.
  - Provide evidence that each configuration item is on track per approved growth curves to meet reliability and maintainability requirements.
- The Army plans to conduct an FOT&E during NIE 13.2 in May 2013 to demonstrate that WIN-T Increment 2 has addressed the operational effectiveness and suitability deficiencies noted in the DOT&E BLRIP report as directed by the September ADM.

Recommendations

- Status of Previous Recommendations. The program successfully addressed one of the three FY10 recommendations. The program still needs to correct deficiencies identified during the WIN-T Increment 2 LUT, complete requirements documents for Increment 3, update the Increment 2 TEMP, and develop an Increment 3 TEMP.
- FY12 Recommendations. The Army should:
  1. Create a reliability growth plan to improve the poor WIN-T Increment 2 reliability highlighted during IOT&E. Reliability improvements should be demonstrated during a future operational test event.
  2. Identify the root causes of the SNE deficiencies, correct the poor performance, and demonstrate its effectiveness in a future operational test event.
  3. Improve HNW and NCW to address deficiencies noted during the IOT&E. Waveform improvements should be demonstrated during a future operational test event.
  4. Complete a post full-rate production TEMP and ensure funding is available to conduct a future operational test to demonstrate improvements in WIN-T Increment 2.

Navy Programs

Navy Programs

Acoustic Rapid Commercial Off-the-Shelf Insertion (A-RCI)

Executive Summary
- The Navy completed FOT&E of Acoustic Rapid Commercial Off-the-Shelf Insertion (A-RCI) Advanced Processor Build 09 (APB-09) in early FY12.
- DOT&E issued a classified FOT&E report for the A-RCI APB-09 system in November 2012, and found the APB-09 system provides performance similar to previous APBs (not improved or degraded).
- The processing and display for the Wide Aperture Array (WAA), a primary focus for APB-09 software upgrades, suffered from significant technical problems that were discovered during initial operational testing. The Navy developed new WAA software intended to fix the problems, conducted limited additional development testing, and issued the new software to the fleet without operational testing.
- The Navy is completing development of the APB-11 version and operational testing is planned to begin in FY13.

System
- A-RCI is an open-architecture sonar system intended to maintain an advantage in acoustic detection of threat submarines.
- A-RCI uses legacy sensors and replaces central processors with commercial off-the-shelf (COTS) computer technology and software. The program includes the following:
  - A sonar system for the *Virginia* class submarine
  - A replacement sonar system retrofitted into *Los Angeles*, *Ohio*, and *Seawolf* class submarines
  - Biannual software upgrades (called Acoustic Processor Builds (APBs)) and hardware upgrades (called Technology Insertions (TIs)). While using the same process and nomenclature, these APBs and TIs are distinct from those used in the AN/BYG-1 Combat Control System program.
- The Navy intends for the A-RCI upgrades to provide expanded capabilities for Anti-Submarine Warfare (ASW), high-density contact management, and mine warfare, particularly in littoral waters and against diesel submarines.
- A-RCI processes data from the submarine's acoustic arrays (i.e., spherical array, hull array, WAA, and high-frequency arrays) along with the submarine's two towed arrays (i.e., the fat line array consisting of the TB-16 or TB-34 and the thin line array consisting of the TB-23 or TB-29).

- The APB-09 introduced upgraded processing on the high frequency array and the ability to process new pulse types. It also introduced advanced signal processing to improve both detection and display performance for the WAA. The Navy intends for the new software to improve ASW search through attack performance with new enhanced narrowband processing algorithms, to improve performance avoiding threat mines, and to improve situational awareness and contact managements for all missions.

Mission
The Navy's intent for submarine crews equipped with the A-RCI sonar is to complete the following submarine force missions:
- Search, detect, and track submarine and surface vessels in open-ocean and littoral sea environments without being counter-detected
- Search, detect, and avoid mines and other submerged objects
- Covertly conduct intelligence, surveillance, and reconnaissance
- Covertly execute Naval Special Warfare missions
- Perform under-ice operations

Major Contractor
Lockheed Martin Maritime Systems and Sensors – Washington, District of Columbia

Activity
- The Navy completed FOT&E of A-RCI APB-09 in early FY12 in accordance with a DOT&E-approved test plan. The Navy combined testing with the AN/BYG-1 Combat Control System, the *Virginia* class submarine, and the Mk 48 Mod 6 Advanced Common Torpedo (ACOT) and Mk 48 Advanced Capability (ADCAP) Mod 7 Common Broadband Advanced

Sonar System (CBASS) programs. Coordinating these tests provided testing efficiencies while enabling an end-to-end evaluation of mission performance.

- DOT&E issued a classified combined test report for the *Virginia* class submarine, the A-RCI sonar, and the AN/BYG-1 Combat Control system in November 2012 that evaluated the effectiveness and suitability of the A-RCI APB-09 system.
- The Navy began drafting a Test and Evaluation Master Plan (TEMP) for the APB-11 and APB-13 A-RCI variant APBs, and expects to issue it by early FY13. As part of these efforts, DOT&E requested the Navy investigate new methods of land-based testing and onboard simulated target injection methods to augment at-sea operational tests. Operational testing of the APB-11 variant of A-RCI is expected to begin in FY13.

Assessment

- The DOT&E classified FOT&E report for the A-RCI APB-09 system concluded the following regarding test adequacy and system performance:
  - Given the data available and the limitations of the test, DOT&E concluded that no evidence existed to change the conclusions about mission performance from previous reports on A-RCI (not improved or degraded). Specifically,
    - For ASW, A-RCI passive sonar capability is effective against older classes of submarines in some environments, but is not effective in all environments or against modern threats.
    - A-RCI is not effective in supporting operator situational awareness and contact management in areas of high-contact density.
    - A-RCI high-frequency mine performance is not effective for some types of minefields, but meets threshold requirements against some mine types under certain environmental conditions.
  - Testing to examine ASW-Attack and situational awareness in a high-surface-ship density environment was adequate for the system tested but not adequate for the software version fielded. The A-RCI processing for the WAA suffered from system development and software problems, which led to poor performance during the operational testing. The Navy investigated this issue after operational testing was completed and subsequently issued software intended to fix the problems. The Navy conducted some limited developmental testing to confirm functionality; however, the Navy has not conducted operational testing to evaluate the updated software or potential changes to mission performance.
  - Test execution to examine the Precision Underwater Mapping capability was not adequate.
  - Several mine shapes in the Navy's training minefield used for the operational testing were severely corroded, damaged, or buried. DOT&E considered the condition of the mine shapes in evaluating high-frequency sonar detection performance and assessed the testing was adequate for some types of threat minefields.
  - A-RCI continues to be not suitable due to problems with reliability and operator training. For APB-09, the Navy lowered the reliability requirements below the previously measured APB reliability. The Navy also refocused the system's new reliability requirements on the minimum system functions necessary for at-sea operations vice what system functions are required for the mission. While APB-09 met the revised lower reliability requirements, the APB-09 system's reliability was significantly below the sonar reliability demonstrated on *Virginia* class submarines during the IOT&E. For other submarine classes, measured sonar APB reliability is statistically unchanged from previous APBs. After operational testing, the Navy reported that software changes were made to the APB-09 software intended to fix the reliability problems identified in testing; these changes have not been evaluated.
  - The Navy revised the Capability Development Document/Capability Production Document performance requirements for A-RCI APB-09. The revised requirements metric focuses development and testing on the time between the A-RCI system displaying acoustic energy and the operator identifying the target. This new metric favors shorter range detections; therefore, a poorly-performing sonar system (shorter range detections) has the potential of scoring better than a long-range detecting system.
- Due to the A-RCI biannual software and hardware development cycle, the Navy generates and approves the A-RCI requirements documents and TEMPs in parallel with APB development and installation. As a result, the fleet assumes additional risk, since most operational testing is not completed before the system is initially deployed.
- The Navy's schedule-driven process prevents operational test results from directly supporting development of the follow-on APBs. For example, the Navy completed operational testing of the A-RCI APB-09 system in early FY12. Due to the combination of the late completion of testing and the Navy's practice of issuing an updated version every two years, data from APB-09 operational testing could not be included in the development of APB-11.
- The development and testing of APB-09 is an example of the high-risk of schedule-driven development and fielding; operational testing revealed significant performance failures with the WAA that were not discovered in developmental testing. Although the Navy issued new software intended to fix the identified problems after the operational test, submarines deployed with a version of A-RCI that the Navy has not operationally tested.

Recommendations

- Status of Previous Recommendations. The Navy is making progress in addressing 23 of the 30 recommendations contained in the APB-00 to APB-07 OT&E reports. The significant remaining unclassified recommendations are:
  1. Improve the detection and localization performance for submarines operating in high-density surface ship environments. Consider investing in automation that will assist the operator in processing the large amount of constantly changing contact data and determining which contacts pose an immediate collision or counter-detection threat.
  2. Improve operator training such that operators understand and effectively employ new APB functionality when fielded. Many of the newly introduced features in APBs that were designed to improve mission performance were not used consistently during the test.
  3. Evaluate the covertness of the high-frequency sonar during a future submarine-on-submarine test.
  4. Investigate the software reliability problems and institute measures to improve system reliability.
  5. Conduct future ASW testing against a high-end diesel-electric submarine (SSK) target to enable a more complete assessment of A-RCI and BYG-1 performance.
- FY12 Recommendations. The Navy should:
  1. Consolidate the A-RCI and AN/BYG-1 TEMPs into an Undersea Enterprise Capstone document.
  2. Re-evaluate operational effectiveness and suitability of A-RCI on a submarine with the new WAA software.
  3. Address the 21 recommendations for the A-RCI and the AN/BYG-1 systems contained in DOT&E's FOT&E report on A-RCI APB-09. Some of the significant unclassified recommendations are:
     - The Navy should improve its developmental testing processes and metrics used to determine if a system potentially improves effectiveness and suitability and to ensure that the system is ready for operational testing and subsequent fielding.
     - Search rate is an important metric for evaluating the ASW search performance. Recently, the Navy issued revised requirements for A-RCI and did not update the platform search rate metric. The new metrics, which assess the difference between the initial operator and post-test laboratory detection times, could improperly result in a poorly performing system (short-range detections) scoring better than a long-range detecting sonar system. DOT&E recommends the Navy re-evaluate the new metrics to improve their robustness under varying environmental conditions and to focus on earlier and longer range operator detections. Also, the Navy should update the operational and environmental conditions for the search rate metric to reflect current threats and threat areas.
     - If future minefield testing requires the use of existing fleet training minefields, a minefield video survey to evaluate the condition and location of the mines should be conducted prior the decision to use the minefield for testing.

Aegis Modernization Program

Executive Summary

- The Navy completed operational testing of Aegis guided missile cruisers (CG-52 through CG-58) upgraded with Aegis Warfare System (AWS) Advanced Capability Build 2008 (ACB08) and Aegis guided missile destroyers (DDG-103 through DDG-112) upgraded with AWS Baseline 7.1R in 1QFY12. The Navy did not scope the ACB08/Baseline 7.1R testing to provide a comprehensive evaluation of effectiveness and suitability. The purpose of these tests was to verify the recent updates did not degrade AWS performance. Based upon operational testing in FY12, the ACB08/Baseline 7.1R AWS performance is consistent with the performance of previous AWS versions, which DOT&E assessed as effective and suitable.
- Operational testing of the ACB08/Baseline 7.1R did not support a full assessment of Aegis effectiveness in the area defense mission. The introduction of AWS Baseline 9 in FY14 introduces new requirements and fields new performance capabilities that are intended to support such an assessment.
- The analysis of test data collected during AWS Baseline 7.1R operational testing and the remaining air defense and suitability portions of AWS ACB08 operational testing is ongoing. DOT&E will issue a formal test report in 2QFY13.

System

- The Navy's Aegis Modernization program provides updated technology and systems for existing Aegis guided missile cruisers (CG-47) and destroyers (DDG-51). This planned, phased program provides similar technology and systems for new destroyers.
- The AWS, carried on DDG-51 guided missile destroyers and CG-47 guided missile cruisers, integrates the following components:
  - AWS AN/SPY-1 three-dimensional (range, altitude, and azimuth) multi-function radar
  - SQQ-89 Undersea Warfare suite that includes the AN/SQS-53 sonar, SQR-19 passive towed sonar array (DDG-51 through DDG-78, CG-52 through CG-73), and the SH-60B or MH-60R Helicopter (DDG-79 and newer have a hangar to allow the ship to carry and maintain its own helicopter)
  - Close-In Weapon System
  - Five-inch diameter gun
  - Harpoon anti-ship cruise missiles (DDG-51 through DDG-78, CG-52 through CG–73)
  - Vertical Launch System that can launch Tomahawk land-attack missiles, Standard surface-to-air missiles, Evolved SeaSparrow Missiles, and Vertical Launch Anti-Submarine Rocket missiles
- The AWS on Baseline 2 Aegis guided missile cruisers (CG-52 through CG-58) was upgraded with commercial off-the-shelf hardware running the AWS software ACB08.
- The AWS on new construction Aegis guided missile destroyers (DDG-103 through DDG-112) is Baseline 7.1R.

Mission

The Joint Force Commander/Strike Group Commander employs AWS-equipped DDG-51 guided missile destroyers and CG-47 guided missile cruisers to:

- Conduct area and self-defense Anti-Air Warfare in defense of the Strike Group
- Conduct Anti-Surface Warfare and Anti-Submarine Warfare
- Conduct Strike Warfare when armed with Tomahawk missiles
- Conduct offensive and defensive warfare operations simultaneously
- Operate independently or with Carrier or Expeditionary Strike Groups, as well as with other joint or coalition partners

Major Contractors

- General Dynamics Marine Systems Bath Iron Works – Bath, Maine
- Northrop Grumman Shipbuilding – Pascagoula, Mississippi
- Lockheed Martin Maritime Systems and Sensors – Moorestown, New Jersey

Activity

- The Navy conducted all portions of the planned operational test of AWS ACB08 in FY10, with the exception of air defense and suitability testing, which it completed in 1QFY12. All testing was conducted in accordance with a DOT&E-approved Test and Evaluation Master Plan and test plan.
- The Navy conducted all portions of the planned operational test of AWS Baseline 7.1R concurrently with the last phase of ACB08 testing in 1QFY12.
- The Navy repaired and examined critical software faults discovered during operational testing of AWS ACB08 in 4QFY12. This testing was conducted in accordance with a DOT&E-approved test plan.
- The Navy continued to deploy AWS ACB08-equipped cruisers and AWS Baseline 7.1R-equipped destroyers in FY12 in advance of operational testing.
- The Navy is preparing an update to the Test and Evaluation Master Plan to incorporate AWS baseline ACB 2012 (ACB12). ACB12 will provide existing and new construction Aegis destroyers an Integrated Air and Missile Defense (IAMD) capability that includes Ballistic Missile Defense (BMD). Current plans will also provide an enhanced Air Defense capability to selected Aegis cruisers without BMD (CGs-59, -60, -62, and -71).

Assessment

- The Navy did not scope the ACB08/Baseline 7.1R testing to provide a comprehensive evaluation of effectiveness and suitability. The purpose of these tests was to verify that the recent updates did not degrade AWS performance. Based upon operational testing in FY12, the ACB08/Baseline 7.1R AWS performance is consistent with the performance of previous AWS versions, which DOT&E assessed as effective and suitable. Analysis of the test data indicates the following:
  - The Air Warfare performance of Aegis cruisers and destroyers, in self-defense posture, is consistent with that of ships with earlier Aegis baselines. Testing did not focus on the area defense capability of the ACB08/7.1R AWS. The Navy intends to conduct an assessment of area defense effectiveness with the introduction of ACB12/AWS Baseline 9 in FY14.
  - The Undersea Warfare performance of Aegis cruisers with AWS ACB08 is consistent with that of ships with earlier Aegis baselines.
  - The Surface Warfare performance of Aegis cruisers and destroyers is consistent with that of ships with earlier Aegis baselines. As previously assessed, Aegis ships have limited ability to counter high-speed surface threats in littoral waters.
- Operational testing of ACB08/Baseline 7.1R in a multi-ship, Cooperative Engagement Capability environment revealed shortcomings in crew proficiency and training not observed in earlier testing that adversely affected Air Warfare performance.
- The analysis of data collected during follow-on testing of AWS ACB08 is still in progress. DOT&E will report on the corrective action in the ACB08 test report in 2QFY13.

Recommendations

- Status of Previous Recommendations. The Navy satisfactorily completed all FY11 recommendations.
- FY12 Recommendations. The Navy should:
  1. Continue to improve Aegis ships' capability to counter high-speed surface threats in littoral waters.
  2. Synchronize future baseline operational testing and reporting with intended ship-deployment schedules to ensure that testing and reporting is completed prior to deployment.
  3. Ensure Aegis crews are proficient in operation of the AWS when in a multi-ship, network environment.

AGM-88E Advanced Anti-Radiation Guided Missile (AARGM) Program

Executive Summary

- The AGM-88E Advanced Anti-Radiation Guided Missile (AARGM) program completed IOT&E and conducted an additional Verification of Correction of Deficiencies (VCD) test period during FY12.
- During FY11/12 operational testing, the Navy completed 185 sorties, accumulating 558 hours of missile operating time. The Navy executed 396 captive-carry runs and fired a total of 12 missiles at actual and simulated threat targets and emitters.
- DOT&E published a classified IOT&E report in 4QFY12.
- AARGM is operationally suitable.
- AARGM is not operationally effective. Although AARGM has the potential to eventually provide some improved combat capability against enemy air defenses, the current weapon configuration has multiple performance shortfalls that largely negate its ability to accomplish its mission.
- The Navy expects the AARGM Block 1 Upgrade to address significant performance shortfalls and provide Full Operational Capability, with the associated FOT&E scheduled to commence in FY14.
- Due to deferred capabilities and IOT&E deficiencies, DOT&E anticipates that AARGM FOT&E requirements exceed the program's currently allocated resources for operational testing. A shortage of AARGM telemetry kits is already identified as a potential hindrance to adequate Block 1 testing.

System

- The AGM-88E AARGM is the follow-on to the AGM-88B/C High-Speed Anti-Radiation Missile (HARM) using a modified HARM body and fins. The Navy intends to employ AARGM on F/A-18C/D/E/F and EA-18G platforms.
- AARGM Block 0, intended for Initial Operational Capability, incorporates digital Anti-Radiation Homing (ARH), GPS, and Millimeter Wave (MMW) guidance, and a Weapon Impact Assessment transmitter.
  - ARH improvements over HARM include an increased field of view and larger frequency range.
  - The GPS allows position accuracy in location, time, and weapon impact assessment transmissions.
  - MMW radar technology allows target discrimination and guidance during the terminal flight phase.
- The Navy expects the AARGM Block 1 Upgrade to deliver Full Operational Capability, including Block 0 capability improvements, as well as an Integrated Broadcast Service Receiver (enables reception of national broadcast data), and software changes to provide deferred capability requirements and address deficiencies identified during IOT&E.

Mission

Commanders employ aircraft equipped with AARGM to conduct pre-planned, on-call, and time-sensitive reactive anti-radiation targeting for the suppression, degradation, and destruction of radio frequency enabled surface-to-air missile defense systems. Commanders receive real-time Weapons Impact Assessments from AARGM via a national broadcast data system.

Major Contractor

Alliant Techsystems, Defense Electronics Systems Division – Woodland Hills, California

Activity

- In 2QFY10, the Navy issued a change to the AARGM Capability Production Document (CPD) due to limitations discovered during developmental testing. This CPD change delayed the start of IOT&E until 3QFY10 to allow correction of system deficiencies; deferred a Key Performance Parameter target requirement to FOT&E; and clarified the acceptable target environment and reactive targeting constraints for IOT&E.
- In accordance with the DOT&E-approved Operational Test Plan (OTP), the Navy's Commander, Operational Test and

Evaluation Force (COTF) commenced AARGM IOT&E in June 2010, but in September 2010, the Navy de-certified AARGM from IOT&E after the program suffered six operational mission failures during initial captive-carry flight tests.

- The AARGM program spent most of FY11 correcting hardware and software deficiencies discovered in developmental testing and during its first IOT&E attempt. In July 2011, DOT&E approved an updated AARGM OTP and the Navy re-initiated dedicated IOT&E in August 2011.
- Immediately following the restart of IOT&E, COTF initiated changes to the OTP that were driven by the 2010 CPD change and deficiencies identified since the first IOT&E attempt was terminated. DOT&E approved the requested changes in October 2011.
- The Navy postponed two live-missile test events scheduled for October 2011 due to an emergent anomaly that caused a communication failure between the AARGM Guidance and Control Sections (GS/CS). The Navy identified a short-term solution for this problem and conducted the live-missile events during 2QFY12.
- Immediately preceding a February 2012 test event involving two other live-missile shots, the Navy notified DOT&E that the planned threat scenario would likely result in mission failure due to a classified AARGM deficiency (details available in the classified DOT&E IOT&E report). Without DOT&E consent, the Navy modified the approved test scenario to alleviate the classified deficiency and proceeded with live-missile testing. DOT&E disagreed with the adjusted threat representation and subsequently assessed these events as operational failures.
- COTF completed IOT&E events in 2QFY12, with initial results indicating AARGM was neither operationally effective nor operationally suitable.
- The Navy subsequently completed software changes to address the two most significant deficiencies identified during IOT&E (GS/CS communication failure and a classified performance shortfall) and subsequently conducted a VCD test period during 3QFY12. DOT&E approved the VCD test plan and included the associated data in its IOT&E assessment.
- During operational testing, the Navy fired a total of 12 missiles at actual and simulated threat targets and emitters. As required by DOT&E, low-rate initial production (LRIP) missiles were used for all events.
- In accordance with DOT&E-approved test plans, the Navy completed 185 operational test sorties, accumulating 558 hours of missile operating time. These totals include sorties and hours accrued during integrated testing that DOT&E considered operationally representative, with the exception of the modified threat scenario mentioned above.
- DOT&E published a classified IOT&E report in 4QFY12.
- The Navy's Milestone Decision Authority (MDA) conducted a Full-Rate Production (FRP) Decision Review during 4QFY12. At that review, the Navy authorized AARGM Block 0 for FRP; however, only the first lot of FRP missiles was approved. Due to AARGM operational effectiveness concerns, the MDA stipulated that a review of FRP and Block 1 progress shall occur before the end of FY13. The MDA intends to base its authorization for another FRP lot on this follow-on review, even though no additional operational testing is planned during FY13.
- The AARGM program hosted an initial T&E Working-level Integrated Product Team meeting in late 4QFY12 to start identifying and coordinating AARGM Block 1 FOT&E requirements. Additional coordination meetings are planned for 1QFY13.

Assessment

- AARGM Block 0 testing was adequate to support an evaluation of the weapon system's operational effectiveness and operational suitability. With the exception of the modified threat scenario mentioned above, the Navy completed testing in accordance with the DOT&E-approved Test and Evaluation Master Plan, OTP, and VCD test plan.
- AARGM Block 0 is operationally suitable. Although the weapon demonstrated poor reliability during IOT&E, the program addressed the primary deficiency affecting reliability and satisfactorily demonstrated this during the VCD test period.
- AARGM Block 0 is not operationally effective. Although AARGM has the potential to eventually provide some improved combat capability against enemy air defenses, the weapon as tested has multiple deficiencies. The details of these deficiencies are detailed in the classified DOT&E IOT&E report. The numerous performance shortfalls identified largely negate AARGM's ability to accomplish its primary mission.
- The Navy expects AARGM Block 1 Upgrade to address significant performance shortfalls and provide Full Operational Capability, with the associated FOT&E scheduled to commence in FY14. DOT&E anticipates that Block 1 FOT&E captive-carry and live-missile firing requirements will exceed the program's currently allocated resources for operational testing. Operational testers have already identified a shortage of AARGM telemetry kits as a potential hindrance to adequate Block 1 testing.

Recommendations

- Status of Previous Recommendations. The two FY11 recommendations remain valid and open. DOT&E requires FOT&E to verify the correction of integrated testing and IOT&E deficiencies and to adequately assess previously deferred capabilities.
- FY12 Recommendations. The Navy should:
  1. Limit FRP quantities until operational effectiveness is properly demonstrated during AARGM Block 1 FOT&E and documented in a DOT&E report.
  2. Ensure adequate inventory of AARGM telemetry kits are available for AARGM FOT&E.

AIM-9X Air-to-Air Missile Upgrade

Executive Summary

- The Navy completed AIM-9X Block II Integrated Testing in March 2012. The Navy assessed 8 of 12 missile shots conducted before the Operational Test Readiness Review (OTRR) as "hits." Developmental testing also included 83 captive-carry missions with telemetry analyzed in detail, and more than 3,700 captive-carry hours for quantifying reliability.
- The Navy and Air Force began IOT&E on April 27, 2012. During operational testing to date, the Navy has completed 10 of 22 planned captive-carry events and 2 of 9 live missile shots. The Air Force has completed 10 of 22 captive-carry flights and 4 of 8 live missile shots. Four of the six live missile shots have passed within lethal radius of the target. The Services plan to complete IOT&E in July 2013.
- As of mid-November 2012, the Services had accomplished 5,460 total captive-carry hours and had 23 failures resulting in a Mean Time Between Captive-Carry Failure (MTBCCF) of 237 hours. The current system reliability is slightly below the value on the reliability growth curve consistent with reaching the requirement of 500 hours MTBCCF at 80,000 hours.

System

- AIM-9X is the latest generation short-range, heat-seeking, air-to-air missile. The currently fielded version of the missile is AIM-9X Block I, Operational Flight Software (OFS) 8.220, which includes limited lock-on-after-launch, full envelope off-boresight capability without a helmet-mounted cueing system, and improved flare rejection performance.
- AIM-9X is highly maneuverable, day/night capable, and includes the warhead, fuze, and rocket motor from the previous AIM-9M missile.
- AIM-9X added a new imaging infrared seeker, vector controlled thrust, digital processor, and autopilot.
- F-15C/D, F-16C/D, and F/A-18C/F aircraft can carry the AIM-9X.
- The AIM-9X Block II is the combination of AIM-9X-2 hardware and OFS 9.3.
  - AIM-9X-2 is the latest hardware version and is designed to prevent parts obsolescence and provide processing capability for the OFS 9.3 upgrade. The AIM-9X-2 missile includes a new processor, a new ignition battery for the rocket motor, an electronic ignition safety/arm device, and the DSU-41/B Active Optical Target Detector (AOTD) fuze/datalink assembly.
  - OFS 9.3 is a software upgrade that is intended to add trajectory management to improve range, datalink with the launching aircraft, improved lock-on-after-launch, target re-acquisition, and improved fuzing.

Mission

Air combat units use the AIM-9X to:

- Conduct short-range offensive and defensive air-to-air combat
- Engage multiple enemy aircraft types with passive infrared guidance in the missile seeker
- Seek and attack enemy aircraft at large angles away from the heading of the launch aircraft

Major Contractor

Raytheon Missile Systems – Tucson, Arizona

Activity

- The Navy completed AIM-9X Block II (AIM-9X-2 with OFS 9.3) developmental testing in March 2012. Developmental testing consisted of 12 free flight shots, 4 of which were conducted with the final software version (OFS 9.311). It also included 83 captive-carry missions with telemetry analyzed in detail, and more than 3,700 captive-carry hours for quantifying reliability.
- The Navy conducted an OTRR in April 2012, and certified readiness for AIM-9X Block II IOT&E under the DOT&E-approved June 2011 TEMP and March 2012 test plan.

- The Navy and Air Force began IOT&E in April 2012. During operational testing to date, the Navy has completed 10 of 22 planned captive-carry events and 2 of 9 live missile shots. The Air Force has completed 10 of 22 captive-carry flights and 4 of 8 live missile shots.
- The Services plan to complete IOT&E in July 2013, with a Full-Rate Production decision in April 2014 and Initial Operational Capability planned for September 2014.

Assessment

- During developmental testing, 9 of 12 total missile shots guided to within lethal radius of the drone. One of those nine missiles did not receive a fuze pulse, resulting in no detonation within proximity of the drone. Therefore, the Navy assessed 8 of 12 shots conducted before the OTRR as "hits."
- All captive-carry missions were nominal, but the Air Force highlighted one performance discrepancy with AIM-9X Block II Helmet-less High Off-Boresight (HHOBS) performance. It is possible that Block II is slower to acquire targets in HHOBS than Block I. The Capability Production Document (CPD) requires the AIM-9X Block II performance be equal to or better than baseline AIM-9X performance.
- At the OTRR, reliability was 232 hours MTBCCF and is projected to reach 316 hours at the end of IOT&E. As of mid-November 2012, the Services had accomplished 5,460 total captive-carry hours and had 23 failures resulting in an MTBCCF of 237 hours. The current system reliability is slightly below the value on the reliability growth curve consistent with reaching the requirement of 500 hours MTBCCF at 80,000 hours. DOT&E will track reliability through IOT&E.
- All Navy and Air Force IOT&E captive-carry sorties to this point have achieved mission objectives. As of November 15, 2012, 4 of 6 live missile shots have been successful. The AIM-9X Block II did not achieve a hit on the fourth shot by the Air Force, attempted in September 2012. It was a lock-on-after-launch shot, which initially locked on the target but then lost track and did not re-acquire. The Navy's first shot, attempted in October 2012, was also unsuccessful. It was another lock-on-after-launch shot that did not acquire the target. Data results are still pending for both unsuccessful attempts. To date, the Air Force and Navy have not reported any weapon system deficiencies during IOT&E.

Recommendations

- Status of Previous Recommendations. The Navy satisfactorily addressed previous recommendations.
- FY12 Recommendation.
  1. The Navy should address the Air Force's concern of HHOBS performance. It should gather data to verify or disprove AIM-9X Block II performance slip during HHOBS performance. If Block II performance is worse than that of Block I in HHOBS, consider a software modification to improve HHOBS performance and comply with the CPD requirement of achieving performance equal to or greater than Block I.

AN/BYG-1 Combat Control System

Executive Summary

- The Navy completed FOT&E of AN/BYG-1 Advanced Processor Build 09 (APB-09) in early FY12.
- DOT&E issued a classified FOT&E report for the AN/BYG-1 APB-09 system in November 2012 and found the APB-09 system provides performance similar to previous APBs (not improved or degraded).
- The processing and display for the Wide Aperture Array (WAA) suffered from significant technical problems that were discovered during operational testing. The WAA is a sonar input to the BYG-1 intended to provide bearing and ranges data to the system. The Navy developed new software intended to fix the WAA problems, conducted limited development testing, and issued the new software to the fleet without further operational testing.
- The Navy is completing development of the APB-11 version and operational testing is planned to begin in FY13.

System

- AN/BYG-1 is an open-architecture submarine combat control system for analyzing and tracking submarine and surface ship contacts, providing situational awareness, as well as the capability to target and employ torpedoes and missiles.
- AN/BYG-1 replaces central processors with commercial off-the-shelf (COTS) computer technology. The Navy installs improvements to the system via an incremental development program. The program includes the following:
  - A combat control system for the *Virginia* class submarine
  - A replacement combat control system back-fit into *Los Angeles*, *Ohio*, and *Seawolf* class submarines
  - Biannual software upgrades (called Advanced Processor Builds (APBs)) and hardware upgrades (called Technology Insertions (TIs)). While using the same process and nomenclature, these APBs and TIs are distinct from those used in the Acoustic Rapid COTS Insertion (A-RCI) program.
- The Navy intends improvements to provide expanded capabilities for Anti-Submarine (ASW) and Anti-Surface Warfare (ASUW), high-density contact management, and the targeting and control of submarine weapons.
- The Navy is also developing AN/BYG-1 for use on the Royal Australian Navy *Collins* class diesel electric submarines.

Mission

Submarine crews equipped with the AN/BYG-1 combat control system are able to complete the following submarine force missions:

- Analyze submarine sensor contact information to track submarine and surface vessels in open ocean and littoral sea environments
- Employ heavyweight torpedoes against submarine and surface ship targets
- Receive strike warfare tasking, plan strike missions, and employ Tomahawk land-attack cruise missiles
- Receive and synthesize all organic sensor data and external tactical intelligence to produce an integrated tactical picture

Major Contractors

- General Dynamics Advanced Information Systems – Fairfax, Virginia
- General Dynamics Advanced Information Systems – Pittsfield, Massachusetts

Activity

- The Navy completed FOT&E of AN/BYG-1 APB-09 in early FY12 in accordance with a DOT&E-approved test plan. The Navy combined testing with the AN/BQQ-10 A-RCI Sonar System, the *Virginia* class submarine, and the Mk 48 Mod 6 Advanced Common Torpedo (ACOT) and Mk 48 Advanced Capability (ADCAP) Mod 7 Common Broadband Advanced Sonar System (CBASS) programs. Coordinating these tests provided testing efficiencies and enabled an end-to-end evaluation of mission performance.
- DOT&E issued a classified combined operational test report in November 2012 that evaluates the effectiveness and suitability of the AN/BYG-1 APB-09 system.
- The Navy began drafting a Test and Evaluation Master Plan (TEMP) for the APB-11 and APB-13 variants of AN/BYG-1, and expects to issue it by early FY13. Operational testing of the APB-11 variant of AN/BYG-1 is expected to begin in FY13.

Assessment

- The Navy's schedule-driven process prevents operational test results from directly supporting development of the follow-on APBs. The Navy completed operational testing of the AN/BYG-1 APB-09 system in 2011. Due to the combination of late completion of testing and the Navy's practice of issuing an updated software and hardware version every two years, data from APB-09 operational testing have not been included in the development of APB-11, which is nearing completion.
- The DOT&E classified combined report to Congress for the *Virginia* class submarine, A-RCI APB-09, and AN/BYG-1 APB-09 systems concluded the following regarding AN/BYG-1 test adequacy and system performance:
  - Given the data available, no evidence exists to change the conclusions about mission performance from previous reports on AN/BYG-1 (not improved or degraded). Specifically,
    - APB-09 is not effective in supporting operator situational awareness and contact management in areas of high-contact density.
    - APB-09 did not meet the Navy's requirements for target localization; however, the targeting solutions were often sufficient for a trained crew to provide the torpedo an opportunity to detect the target. Nevertheless, the APB-09 variant remains not effective in ASW scenarios.
    - DOT&E's overall assessment of Information Assurance was unchanged from the APB-07 variant (not effective), although the new software represents an improvement in Information Assurance over previous systems.
    - APB-09 is operationally suitable and continues to exhibit excellent reliability and availability; however, the Navy needs to improve APB training.
  - Testing to examine missions involving ASW-Attack, situational awareness, and contact management in areas of high-contact density was adequate for the system tested but not adequate for the software version fielded on *Virginia* class submarines. The AN/BQQ-10 A-RCI processing for the WAA suffered from system development problems, which led to poor performance during the operational testing. AN/BYG-1's contribution to the ASW mission performance and submarine mission operations in areas of high-contact density was hindered due to these problems. The Navy investigated the WAA issues after operational testing was completed and subsequently issued software fixes intended to correct the problems. The Navy conducted some limited developmental testing to confirm functionality; however, the Navy has not completed operational testing to evaluate the updated WAA software effects on BYG-1 performance. DOT&E assesses that the completed operational testing allows for an adequate assessment of the performance on *Los Angeles* class and *Ohio* class submarines that do not have a WAA.
  - The new BYG-1 route planning tools were unable to be fully evaluated due to the lack of required databases and crew training.

Recommendations

- Status of Previous Recommendations. The Navy has made progress in addressing four of the seven outstanding recommendations contained in previous annual reports and test reports. The remaining significant unclassified recommendations are:
  1. Improve the detection and localization performance for submarines operating in high-density surface ship environments. Consider investing in automation that will assist the operator in processing the large amount of constantly changing contact data and determining which contacts pose an immediate collision or counter-detection threat.
  2. Improve operator training such that operators understand and effectively employ new APB functionality when fielded.
  3. Conduct future ASW testing against high-end targets simulating modern threat diesel-electric submarines (SSK) to enable a more complete assessment of A-RCI and BYG-1 performance. Since acoustic sensors and environmental conditions effect the system's performance, testing should be conducted using the Navy's tactical sensor combinations and in a variety of threat-like environments.
- FY12 Recommendations.
  1. DOT&E published a classified APB-09 FOT&E report in November 2012. That report identifies 21 recommendations that the Navy should address for the A-RCI sonar system and the AN/BYG-1 combat control systems. In particular, the Navy should re-evaluate operational effectiveness on a submarine with a repaired WAA.
  2. The Navy should consolidate the A-RCI and AN/BYG-1 TEMPs and test plans into an Undersea Enterprise Capstone document to permit efficiencies in testing.
  3. The Navy should improve its developmental testing processes and metrics used to determine if a system potentially improves effectiveness and suitability and to ensure that the system is ready for operational testing and subsequent fielding.

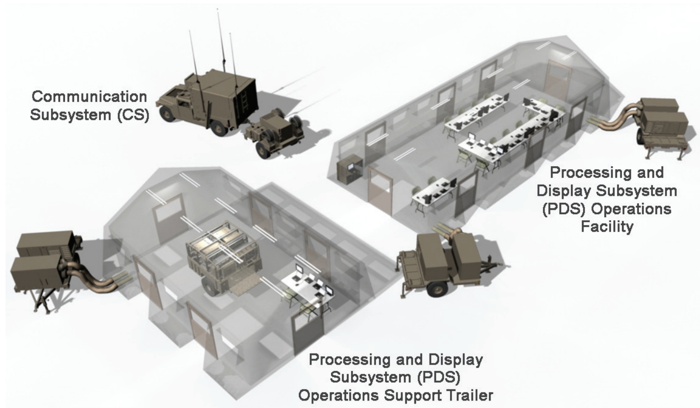
Common Aviation Command and Control System (CAC2S)

Executive Summary

- In September 2011, DOT&E assessed that the Common Aviation Command and Control System (CAC2S) Phase 1 IOT&E was not adequate due to test venue limitations and insufficient data collection. As a result, DOT&E could not determine CAC2S operational effectiveness and suitability.
- In September 2011, the Assistant Secretary of the Navy, Research, Development, and Acquisition, as the Milestone Decision Authority (MDA), led the Full Deployment Decision Review. The MDA subsequently approved Phase 1 full deployment of CAC2S and directed the CAC2S program manager to conduct additional testing to address recommendations by DOT&E and the Marine Corps Test and Evaluation Activity (MCOTEA) based on deficiencies identified during the IOT&E.
- In June 2012, the Marine Corps completed a Limited User Evaluation (LUE) for CAC2S Increment 1, Phase 1 that satisfactorily addressed previously identified key DOT&E and MCOTEA deficiencies.
- Based on data collected during the LUE combined with that from the IOT&E, DOT&E assessed CAC2S Increment 1, Phase 1 as operationally effective and operationally suitable in an October 2012 Major Automated Information System report for CAC2S Increment 1, Phase 1.

System

- CAC2S is designed to provide Marine Corps operators with the ability to share mission-critical voice, video, sensor, and command and control data and information in order to integrate aviation and ground combat planning and operations in support of the Marine Air-Ground Task Force (MAGTF).
- CAC2S consists of tactical shelters, software, and common hardware. The hardware components are expeditionary, common, modular, and scalable, and may be freestanding, mounted in transit cases, or rack-mounted in shelters and/or general purpose tents that are transported by organic tactical mobility assets.
- CAC2S Increment 1 is comprised of three functional subsystems to be delivered in two phases.
  - Phase 1:
    - Processing and Display Subsystem (PDS) – Provides the operational command post and functionality to support mission planning, decision making, and execution tools for all aspects of Marine Aviation.
    - Communication Subsystem (CS) – Provides the capability to interface with internal and external communication assets and the means to control their operation.
  - Phase 2:
    - Sensor Data Subsystem (SDS) – Provides an open-architecture interface capable of integrating emerging active and passive sensor technology for organic and non-organic sensors of the Marine Air Command and Control System (MACCS).
- CAC2S Phase 1 includes the PDS and CS to establish the baseline Direct Air Support Center (DASC) for the Marine Air Support Squadron and limited Tactical Air Operations Center (TAOC) mission functionality for the Marine Air Control Squadron. During Phase 2, SDS is intended to enhance the CAC2S and meet remaining MACCS aviation battle management command and control requirements to include fusion of real-time data.



CAC2S Increment I, Phase I

Mission

- The MAGTF Commander will employ CAC2S to integrate Marine Corps aviation into joint and combined air/ground operations in support of Operational Maneuver from the Sea, Sustained Operations Ashore, and other expeditionary operations. The CAC2S will support the MAGTF command and control concept and will provide an expeditionary and common joint air command and control capability.
- The MAGTF Commander will execute command and control of assigned assets afloat and ashore in a joint, allied, or coalition operational environments by using CAC2S capabilities to:
  - Display a common, real and near real-time integrated tactical picture with the timeliness and accuracy

necessary to facilitate the control of friendly assets and the engagement of threat aircraft and missiles
- Access theater and national intelligence sources from a single, multi-function command and control node
- Standardize Air Tasking Order (ATO) and Airspace Control Order generation, parsing, interchange, and dissemination throughout the MAGTF and theater forces by using the joint standard for ATO interoperability

Major Contractors
- Phase 1
  - Government Integrator: Naval Surface Warfare Center – Crane, Indiana
  - Component Contractor: Raytheon-Solipsys – Fulton, Maryland
  - Component Contractor: General Dynamics – Scottsdale, Arizona
- Phase 2: General Dynamics – Scottsdale, Arizona

Activity
- In September 2011, DOT&E assessed that the CAC2S Phase 1 IOT&E was not adequate due to test venue limitations and insufficient data collection. As a result, DOT&E could not determine CAC2S operational effectiveness and suitability.
- In September 2011, the Assistant Secretary of the Navy, Research, Development, and Acquisition, as the MDA, led the Full Deployment Decision Review. The MDA subsequently approved Phase 1 full deployment of CAC2S and directed the CAC2S program manager to conduct additional testing to address test inadequacies and deficiencies identified by DOT&E and MCOTEA during the IOT&E.
- The Marine Corps conducted an LUE in accordance with a DOT&E-approved test plan to address prior limitations in test adequacy and to test corrections for CAC2S deficiencies identified during the IOT&E. The test was divided into two phases. The Marine Corps conducted Phase 1 testing during the Weapons and Tactics Instructor's Course (WTI) exercise at Marine Corps Air Station Yuma, Arizona, in April 2012. The Marine Corps conducted Phase 2 testing at the Marine Corps Tactical Systems Support Activity in June 2012.
- The Marine Corps began test planning for Phase 2 of CAC2S in FY12. IOT&E is scheduled for FY15.

Assessment
- The primary objectives of LUE Phase 1 testing were to assess the TAOC mission in an operationally realistic environment and CAC2S's ability to support continuous operations during DASC displacement. The primary objectives of LUE Phase 2 testing were to assess accuracy and timeliness of the Common Tactical Picture, Joint Range Extension Application Protocol A/B connectivity, Global Command and Control System integration, Advanced Field Artillery Data System integration, and maximum track processing capability. Data collected during both phases of the LUE were used to assess system reliability, availability, and maintainability.
- The LUE satisfactorily addressed key deficiencies previously identified, and there were no major limitations to testing. The minor limitations of not having the Service-level preventative maintenance plan established, as well as not having a logistics spares and delivery structure in place, did not hinder the overall assessment. The WTI exercise, during which the LUE was conducted, did allow sufficient data collection to resolve TAOC effectiveness operations. The combination of both IOT&E and LUE testing provided adequate data to assess the operational effectiveness and suitability of CAC2S.
- The CAC2S is operationally effective in its primary mission to support the DASC and TAOC. DASC operators were able to use the CAC2S to support direct air support missions during both the IOT&E and LUE. The CAC2S Common Tactical Picture provided DASC operators with timely, accurate, and relevant information. Early Warning and Control TAOC operators were able to use the CAC2S communications capabilities to support airspace surveillance, air direction and control, coordination of air assets, and weapons systems integration during the LUE.
- The CAC2S is operationally suitable. The combination of data from both the IOT&E and LUE are adequate to assess reliability, availability, and maintainability. DASC and TAOC operators were able to consistently employ the system in the operationally representative environment provided during WTI operations. The reliability of completing a 24-hour mission was 88 percent, and the estimated Mean Time Between Operational Mission Failure was 192 hours. The operational availability was calculated as 97.9 percent.

Recommendations
- Status of Previous Recommendations. The Marine Corps addressed all previous FY10 and FY11 recommendations.
- FY12 Recommendations. The Marine Corps should:
  1. Ensure that future test venues for Phase 2 IOT&E provide for a balanced use of air and ground combat forces along with a 24-hour operational window to ensure adequate system operating hours for assessment of system reliability. In order to reduce risk, an operational assessment should be conducted prior to IOT&E that assesses functionality, integration, and employment for all MACCS users.
  2. Develop and implement a data collection plan to aid in assessment of reliability, availability, and maintainability requirements of currently fielded systems and use the data to supplement the evaluations of Phase 2.
  3. Establish requirements for and develop a Service-level preventative maintenance plan.
  4. Conduct a supportability assessment to assess the availability of logistic support and spares for Phase 2.

CV-22 Osprey

Executive Summary

- Air Force Special Operations Command (AFSOC) conducted recent operational testing of upgrades to the Directional Infrared Countermeasure (DIRCM) and Suite of Integrated Radio Frequency Countermeasures (SIRFC) systems that demonstrated improvements in countermeasure effectiveness.
- AFSOC completed operational assessments of ramp-mounted machine guns and flight control software in FY12.
- AFSOC plans to evaluate improvements to the icing protection and communications systems in FY13.

System

- There are two variants of the V-22: the Marine Corps MV-22 and the Air Force/U.S. Special Operations Command (USSOCOM) CV-22. The air vehicles for Air Force and Marine Corps missions are nearly identical, with common subsystems and military components sustainable by each Service's logistics system.
- The CV-22 is the replacement for aging Special Forces MH-53 helicopters. It is a tilt-rotor aircraft capable of conventional fixed-wing flight and vertical take-off and landing over the range of Special Operations missions.
- Its speed and range enable the ability to support Special Operations mission demands that were not possible with legacy rotary- or fixed-wing aircraft.
- The CV-22 can carry 18 combat-ready Special Operators 538 nautical miles (nm) and return. It can self-deploy up to 2,100 nm with one aerial refueling.
- The CV-22 will augment Air Force Special Operations MC-130 aircraft. It has terrain-following/terrain-avoidance radar, an advanced multi-frequency communication suite, and a more robust electronic defense suite.
- Future capabilities will include engine sub-assembly upgrades, strategic refueling capability, and various fixes to deficiencies identified during IOT&E.

Mission

Air Force squadrons equipped with the CV-22 will provide high speed, long-range insertion and extraction of Special Operations Forces to and from high-threat objectives.

Major Contractors

Bell-Boeing Joint Venture:

- Bell Helicopter – Amarillo, Texas
- The Boeing Company – Ridley Township, Pennsylvania

Activity

- To address deficiencies with electronic defense systems discovered during the 2008 CV-22 IOT&E, AFSOC tested upgraded hardware and software of the DIRCM (April through June 2010) and SIRFC (April through July 2012).
- The CV-22 program relocated communication antennas to address limited operating range and inadequate reliability with the CV-22 radios demonstrated during the 2008 IOT&E.
- AFSOC conducted operational assessments of the GAU-18 and GAU-21 .50 caliber Upgraded Ramp-Mounted Weapon System in March through June 2012. AFSOC had modified these machine guns to improve weapons reliability following brownout landings.
- AFSOC evaluated the Tactical Software Suite 10.3.01 in March through April 2012. The major feature of this software version was the addition of the capability to perform coupled or uncoupled tactical approaches (during a coupled approach, flight crew utilize autopilot to fly the aircraft; during an uncoupled approach, the flight crew fly the aircraft manually).

Assessment

- DOT&E evaluated the DIRCM system during the CV-22 IOT&E in 2009 and reported significant reliability and performance shortfalls. Since IOT&E, AFSOC upgraded the CV-22 DIRCM with a new system processor, updated software, and Guardian Laser Transmitter Assembly designed to reduce system weight and to improve system reliability. AFSOC tested the hardware and software upgrades to the CV-22 DIRCM and the upgrades meet performance

requirements. IOT&E reliability failures have not resurfaced during testing or fielding.
- DOT&E evaluated the SIRFC system during the IOT&E and reported substantial significant shortfalls in providing threat situational awareness and limited countermeasure effectiveness. DOT&E also reported a high rate of reliability failures during IOT&E. Since IOT&E, AFSOC upgraded the CV-22 SIRFC with new high-power transmitters, cabling, radio-frequency switches, antennas, and Block 7 Operational Flight Software with over 140 changes to correct system deficiencies; nonetheless, some deficiencies remain outstanding. Analysis of the SIRFC test data from FY12 testing is ongoing and will be reported in 2013.
- The GAU-18 .50 caliber Upgraded Ramp-Mounted Weapon System is not effective or suitable for fielding. Dust covers proposed for the GAU-18 did not protect the weapon from dust intrusion and resulted in numerous broken extractor pins.
- In testing, the GAU-21 demonstrated potential for reliable performance following exposure to brownout conditions. Repeated brownout landings did not adversely affect the rate of fire.
- The Tactical Software Suite 10.3.01 enabled pilots to conduct coupled and uncoupled tactical approaches. This enhancement reduces pilot workload when coupled approaches are feasible.
- While the program has made progress in improving CV-22 radio effectiveness and reliability, further testing and assessment is needed. Additionally, deficiencies with the Icing Protection System remain. Improvement and further testing is needed in both areas.
- No development or testing has been accomplished to address aerial refueling from strategic tankers.
- No additional flight testing or engineering analysis have been performed, indicating a change would be appropriate to DOT&E's September 2005 assessment that the V-22 cannot perform autorotation to a survivable landing.

Recommendations
- Status of Previous Recommendations. The program addressed all but one of the previous recommendations. The recommendation regarding development of battle damage repair procedures and fire suppression systems for the aircraft dry bays remains valid.
- FY12 Recommendations.
  1. The program should address deficiencies with the multi-mission advanced tactical terminal and the strategic refueling capability as documented in IOT&E and then operationally test the fixes.
  2. AFSOC should proceed with plans to evaluate communications effectiveness and reliability in FY13.
  3. AFSOC should proceed with plans to evaluate reliability fixes to the Icing Protection System under operationally representative icing conditions in FY13.

CVN-78 *Gerald R. Ford* Class Nuclear Aircraft Carrier

Executive Summary

- The current Test and Evaluation Master Plan (TEMP) does not adequately address integrated platform-level developmental testing, significantly raising the likelihood that platform-level test problems will be discovered during IOT&E. The Program Office has begun to address the problem and has refined the post-delivery schedule. However, the details as to the extent of any additional integrated platform-level CVN-78 developmental tests are unclear.
- The Navy began CVN-78 construction in 2008 and plans to deliver the ship in September 2015. Current progress supports this plan; however, the Electro-Magnetic Aircraft Launch System (EMALS), Advanced Arresting Gear (AAG), Dual Band Radar (DBR), and Integrated Warfare Systems will continue to drive the timeline for successful delivery of the ship.
- The Navy continues to work on integration deficiencies related to the F-35 Joint Strike Fighter (JSF) and its fleet of aircraft carriers, including CVN-78.
- Although CVN-78 will include a new heavy underway replenishment (UNREP) system that will allow transfer of 12,000-pound cargos, the Navy's plan to install heavy UNREP systems on resupply ships has slipped eight years.
- DOT&E rescinded approval of the alternative LFT&E Management Plan pertaining to the *Gerald R. Ford* (CVN-78) class carrier program because the Navy unilaterally decided to modify the previously approved LFT&E plan. The Navy wanted to limit the scope of the Total Ship Survivability Trial (TSST) on CVN-78 to conform to the Navy budget, and to defer the Full-Ship Shock Trial (FSST) to CVN-79, a change to the previously approved LFT&E Management Plan with which DOT&E does not concur.

System

- The CVN-78 *Gerald R. Ford* class nuclear aircraft carrier program is a new class of nuclear powered aircraft carriers that replaces the previous CVN-21 program designation. It has the same hull form as the CVN-68 *Nimitz* class, but many ship systems, including the nuclear plant and the flight deck, are new.
- The newly designed nuclear power plant is intended to reduce reactor department manning by 50 percent and produce significantly more electricity when compared to a current CVN-68 class ship.
- The CVN-78 will incorporate electromagnetic catapults (instead of steam-powered), and have a smaller island with a DBR (a phased-array radar which replaces/combines five legacy radars used on current aircraft carriers).
- The Navy intends for the Integrated Warfare System to be adaptable to technology upgrades and varied missions throughout the ship's projected operating life including increased self-defense capabilities when compared to current aircraft carriers.
- The Navy redesigned weapons stowage, handling spaces, and elevators to reduce manning, increase safety, and increase throughput of weapons.
- The Navy designed CVN-78 to increase the sortie generation capability of embarked aircraft to 160 sorties per day (12-hour fly day) and to surge to 270 sorties per day (24-hour fly day) as compared to the CVN-68 *Nimitz* class sortie generation rate demonstration of 120 sorties per day/240 sorties for 24-hour surge.
- The Consolidated Afloat Networks and Enterprise Services (CANES) program replaces five shipboard legacy network programs to provide a common computing environment for command, control, intelligence, and logistics.
- The Navy plans to declare CVN-78 Initial Operational Capability in FY17 with Full Operational Capability in FY18 after the Milestone C decision.

Mission

Carrier Strike Group Commanders will use the CVN-78 to:

- Conduct power projection and strike warfare missions using embarked aircraft
- Provide force protection of friendly units
- Provide a sea base as both a command and control platform and an air-capable unit

Major Contractor

Huntington Ingalls Industries, Newport News Shipbuilding – Newport News, Virginia

Activity

Test Planning

- The Navy continues to develop the CVN-78 Sortie Generation Rate (SGR) (number of aircraft sorties per day) test concept. Discussions have focused on the specific details of live testing days (e.g., which test ranges to use, how many aircraft, which weapons). The ship's SGR requirement is based on a 30-plus-day wartime scenario. DOT&E concurs with the proposed 6 consecutive 12-hour fly days followed by 2 consecutive 24-hour fly days. This live testing will be supplemented with modeling and simulation from the Virtual Carrier model to extrapolate results to the 30-plus-day SGR requirement.
- DOT&E approved an operational assessment that began in September 2012, to assess the progress of the CVN-78 build and its ability to successfully undergo operational test and evaluation in the future. The assessment is being led by U.S. Navy's Commander, Operational Test and Evaluation Force and is a five-month series of site visits and evaluations by fleet experienced operators who will perform a detailed analysis of the carrier and all its major subcomponents. This review is expected to be completed in 2QFY13 and will be used to inform the Defense Acquisition Board decision regarding future procurement of CVN-79.
- The CVN-78 *Gerald R. Ford* class carrier program Office is revising the TEMP in an effort to align planned developmental tests with corresponding operational test phases and to identify needed platform-level developmental testing. As part of this process, the Program Office recently released a Post Delivery Test and Trials schedule.

EMALS

- The EMALS system functional design test site at Joint Base McGuire-Dix-Lakehurst, New Jersey, continues to test the new electromagnetic catapult system.
- The Navy completed Phase I of Aircraft Compatibility Testing and installed a re-designed armature. Additionally, the system was reconfigured to enable testing of simulated shared energy storage and simulated shared power conversion to provide an early examination of multiple catapults on a carrier.

AAG

- The Navy is testing the AAG on a jet car track at Joint Base McGuire-Dix-Lakehurst, New Jersey. Earlier testing prompted design changes for the system's Water Twisters, Cable Shock Absorbers, Inverters, and Purchase Cable Drum frames. In August 2012, the program completed two test milestones that validated system performance in the uppermost regions of the system performance envelope. AAG performance testing began in September 2012.
- As of October 2012, about one third of AAG hardware items have been delivered to the shipyard.

JSF

- The Navy completed land-based JSF testing associated with the Jet Blast Deflector (JBD). The JBD is designed to deflect engine exhaust during catapult launches.

CANES

- The Navy conducted developmental testing on the unit-level CANES configuration used on Aegis destroyers in the lab from July 11 – 24, 2012. The Navy has scheduled developmental and follow-on testing of the force-level CANES configuration used on the *Nimitz* and *Gerald R. Ford* classes for the 4QFY14.

DBR

- The Navy is reactivating the Engineering Development Model of the Volume Search Radar portion of the DBR at the surface Combat System Center at Wallops Island, Virginia. In addition, the Navy is installing a production Multi-Functional Radar component of DBR to establish capability by January 2013 to support CVN-78 combat system integration and test.
- The Navy plans to conduct DBR testing at Wallops Island, Virginia, to verify the radar will meet CVN-78's Air Traffic Control requirements in January 2013. The Navy will also begin CVN-78 combat system integration testing with DBR in April 2013.

LFT&E

- DOT&E rescinded approval of the alternative LFT&E Management Plan pertaining to the *Gerald R. Ford* class carrier program because the Navy unilaterally decided to modify the previously approved LFT&E plan. The Navy informed DOT&E of its intent to limit the scope of the TSST on CVN-78 to conform to the Navy budget. While progress has been made toward reaching consensus on the scope of the TSST, the budget has not been adjusted accordingly. The Navy also deferred the FSST to CVN-79, a change to the previously approved LFT&E Management Plan with which DOT&E does not concur. Though the change is motivated by the desire to reduce the gap in available carriers caused by the retirement of the USS *Enterprise,* the delay due to the FSST is minimal, and only a small portion of the already substantial delay caused by other factors. The benefit of having test data to affect the design of future carriers in the class outweighs the delay.

Assessment

Test Planning

- The current state of the Virtual Carrier model does not fully provide for an accurate accounting of SGR due to a lack of fidelity regarding manning and equipment/aircraft availability. Spiral development of the Virtual Carrier model continues in order to ensure that the required fidelity will be available to support the SGR assessment during IOT&E.
- The current TEMP does not adequately address whole platform-level developmental testing. The Program Office has begun to address the problem and has refined the Post Delivery Test and Trials schedule. The details are unclear on the extent of any additional integrated platform-level CVN-78 developmental tests. Lack of platform-level

developmental testing significantly raises the likelihood of the discovery of platform-level problems during IOT&E.

- The Navy plans to deliver CVN-78 in September 2015. Current progress supports this plan; however, the EMALS, AAG, DBR, and Integrated Warfare Systems remain pacing items for successful delivery of the ship.

EMALS

- DOT&E holds moderate concern regarding the performance risk generated by the inability to test the full four-catapult electrical distribution system prior to initial trials aboard ship. This concern is partially mitigated by the current phase of test using a simulated shared electrical storage and shared power conversion at the EMALS system functional design test site in Joint Base McGuire-Dix-Lakehurst, New Jersey.

AAG

- Significant redesign of multiple components has slowed development of AAG development. The program will begin performance testing in FY13.

JSF

- JBD testing identified no deficiencies for catapult launch operations of JSF at military rated thrust. The tests did, however, determine that additional JBD side panel cooling (SPC) and other adjustments are required for operations at combat rated thrust, i.e., with afterburner. The existing JBD panels will need to be replaced with new panels with SPC to be fully JSF-compatible. JBD panels with SPC are form, fit, and function replacements and will be installed after CVN-78 delivers.
  - JSF data flow aboard ship via the Autonomic Logistics Information System (ALIS) is critical to proper F-35 maintenance. Currently, the ALIS system has provided all required parametric information to interface properly with CANES, but CANES is not fully developed yet, as the contract was awarded in August 2012. ALIS is expected to undergo Application Integration Process testing in FY13 to ensure proper interface with CANES. DOT&E will be able to better assess the impact on JSF operations aboard CVN-78 after the test. Currently, data are planned to be exchanged manually until ALIS and CANES properly interface.
  - In 2007, the Program Office identified discrepancies with the integration of the JSF's F135 engine onto aircraft carriers. The weight of the F135 power module, approximately 10,000 pounds, exceeds the limit of current underway replenishment (UNREP) systems. Although CVN-78 will include a heavy UNREP system that will allow transfer of 12,000 pounds, supply ships must include the new system for power module transfer to occur. The Navy's plan to install heavy UNREP systems on resupply ships has slipped eight years.
- Navy Fleet Force's JSF "day-in-the-life" analysis identified a significant number of aircraft-ship interface deficiencies that must be accomplished by the Navy in post-delivery ship modification. They include the following:
  - JSF battle damage assessment and non-traditional Intelligence, Surveillance, and Reconnaissance information captured on the Portable Memory Device or cockpit video recorder cannot be shared real-time with the Distributed Common Ground System-Navy (DCGS-N). This prevents assessment by shipboard intelligence analysts for inclusion in mission reports.
  - Ships are unable to receive and display Link 16 imagery; this problem is not unique to JSF. The Combatant Commanders have stated a need to display imagery to intelligence analysts and operations command and control nodes to enhance engagement decisions.
  - Limited shipboard capabilities exist with expeditionary Link 16. The Navy is considering a program of record to distribute imagery to analysts and maritime operations command and control nodes (e.g., carriers and amphibious ships). This would be a temporary workaround for the DCGS-N post-flight data gap.
  - The JSF Prognostic Health Maintenance (PHM) downlink design for ships is not mature. The uncertainty in the technical characteristics of the final design means that there are potential challenges to integrating PHM into current shipboard communications suites and networks. These challenges include unidentified Information Assurance considerations and unidentified waveform hosting and interfacing.
  - The JSF wheel supplier's recent rim inspection requirement may force a significant increase in shipboard tire and wheel storage requirements. The JSF Program Office is currently working to determine the effect of this deficiency and the need for inspection by the wheel supplier.

DBR

- Previous testing of Navy combat systems similar to CVN-78's revealed numerous integration problems that degrade the performance of the combat system. The previous results emphasize the necessity of maintaining a DBR/CVN-78 combat system asset at Wallops Island. The Navy is considering long-term plans (i.e., beyond FY15) for testing DBR at Wallops Island, Virginia, but it is not clear if a Multi-Functional Radar and funding will be available. Such plans are critical to delivering a fully capable combat system and ensuring lifecycle support after CVN-78 delivery in 2015.

LFT&E

- While the Navy has made substantial effort in component and surrogate testing, this work does not obviate the need to conduct the FSST to gain the critical empirical data that past testing has repeatedly demonstrated are required to rigorously evaluate the ship's ability to withstand shock and survive in combat. Shock Trials conducted on both the *Nimitz* class aircraft carrier and the *San Antonio* class Amphibious Transport Dock demonstrated the need for and substantial value of conducting the FSST. Postponing the FSST until CVN-79 would cause a five- to seven-year delay

in obtaining the data critical to evaluating the survivability of the CVN-78 and would preclude timely modification of subsequent ships of this class to assure their survivability.
- The Navy proposes delaying the shock trial by five to seven years because of the approximately four- to six-month delay required to perform the FSST. The delay is not a sufficient reason to postpone the shock trial, since the shock trial could reveal valuable lessons, including previously unknown vulnerabilities.
- DOT&E has requested the Navy adequately fund and complete the actions necessary to conduct the TSST on the CVN-78. This includes updating the Damage Scenario Based Engineering Analyses (DSBEA) from prior Vulnerability Assessment Reports and enough new DSBEAs, including machinery spaces, to conduct an adequately scoped TSST. DOT&E expects this will require five or six TSST drills. While progress has been made toward reaching consensus on the scope of the TSST, there is still work to be done, mainly to include the machinery spaces, and the budget has not been adjusted to adequately support the TSST.

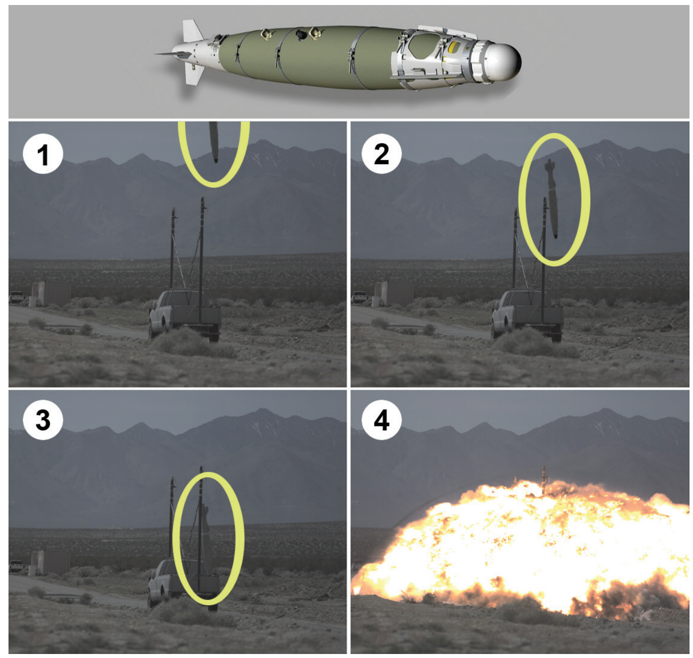
Recommendations

- Status of Previous Recommendations. The Navy addressed one of eight previous recommendations but the following seven remain valid:
  1. Adequately test and address integration challenges with JSF; specifically logistics (storage of spare parts and engines, transport of support equipment and spares to/from the carrier), changes required to JBDs, changes (due to heat and or noise) to flight deck procedures, and ALIS integration.
  2. Finalize plans that address CVN-78 integrated warfare system engineering and ship's self-defense system discrepancies prior to the start of IOT&E.
  3. Continue aggressive EMALS and AAG risk-reduction efforts to maximize opportunity for successful system design and test completion in time to meet required in-yard dates for shipboard installation of components.
  4. Continue development of a realistic model for determining CVN-78's SGR, while utilizing realistic assumptions regarding equipment availability, manning, and weather conditions for use in the IOT&E.
  5. Provide scheduling, funding, and execution plans to DOT&E for the live SGR test event during the IOT&E.
  6. Continue to work with the Navy's Bureau of Personnel to ensure adequate depth and breadth of required personnel to ensure that the 100 percent Navy Enlisted Classification fit/fill manning requirements of CVN-78 are met.
  7. Conduct system-of-systems developmental testing to preclude discovery of deficiencies during IOT&E.
- FY12 Recommendations. None.

Direct Attack Moving Target Capability (DAMTC)

Executive Summary

- The Direct Attack Moving Target Capability (DAMTC) is a non-developmental program that expands the employment envelope of the original Laser Joint Direct Attack Munition (LJDAM) that was fielded in response to an Urgent Operational Need (UON) requirement. DAMTC expands the UON LJDAM's capability from a simple moving target to a more challenging maneuvering target. A maneuvering target is a target that is moving but changes velocity, direction, or both during the time it is engaged.
- The Navy conducted operational testing between November 2011 and April 2012 resulting in a Full-Rate Production decision in June 2012.
- The Navy dropped 22 LJDAM weapons in FY12 during the DAMTC LJDAM operational testing.



System

- The JDAM is a low-cost, autonomously controlled, adverse weather, accurate guidance kit tailored for Air Force/Navy general purpose bombs to include:
  - 2,000-pound Mk 84 and BLU-109 bombs
  - 1,000-pound Mk 83 and BLU-110 bombs
  - 500-pound Mk 82, BLU-111, BLU-126, and BLU-129/B bombs
  - A GPS-aided inertial navigation system that provides primary guidance to the weapon. Augmenting the JDAM inertial navigation system with GPS signals enhances accuracy.
- Guidance and control designs enable accuracy of less than 5 meters when GPS is available and less than 20 meters when GPS is absent or jammed after release.
- The LJDAM provides the capability to attack moving targets by enabling such targets to be illuminated with laser energy that LJDAM's seeker detects and tracks. In addition to retaining the precision of JDAM when used against stationary targets, the LJDAM provides precise laser target designation to eliminate Target Location Error, ability to operate beneath a cloud layer, and the ability to select weapon impact angle in combination with laser-guided precision. LJDAM's laser guidance allows for self-lasing by the engaging aircraft or buddy-lasing by another aircraft or a ground-party.
- The Navy established DAMTC as a program of record in February 2010 and selected LJDAM as the non-developmental material solution.

Mission

- Combatant Commanders use JDAMs employed by fighter, attack, and bomber aircraft, to engage targets day or night, in all weather at the strategic, operational, and tactical levels of warfare.
- Combatant Commanders employ JDAM against fixed and relocatable soft and hard targets, to include command and control facilities, airfields, industrial complexes, logistical and air defense systems, lines of communication, and all manner of battlefield forces and equipment.
- Combatant Commanders employ the UON LJDAM to engage stationary targets using JDAM-type tactics, as well as to reactively engage stationary and moving targets.
- The Navy and Marine Corps intend to use the moving and maneuvering target capability of the DAMTC LJDAM for Close Air Support, Strike Coordination and Armed Reconnaissance, and Time Sensitive Target missions to strike armored and unarmored vehicles, both maneuvering and stationary, due to their potential to start maneuvering.

Major Contractor

The Boeing Company, Integrated Defense Systems – St. Charles, Missouri

Activity

- The Navy's Commander, Operational Test and Evaluation Force (COTF) initiated operational testing in November 2011. Testing incorporated 22 DAMTC LJDAM weapon deliveries using F/A-18 and AV-8B aircraft from VX-9 against 18 moving and 4 stationary targets. The Navy completed IOT&E testing in April 2012.
- The Navy established DAMTC as a program of record in February 2010, selecting LJDAM as the non-developmental material solution. An updated laser sensor lens necessitated limited integrated and developmental testing prior to commencement of operational testing.
- The LJDAM employment history showed significant degradation of the lens when deployed in harsh environments (such as Afghanistan). The Navy initiated a search for a replacement material and Boeing developed a Sapphire lens to replace the existing glass lens.
- The Navy conducted a six-weapon developmental test phase, using side-by-side comparison testing between the two lens types, immediately prior to the operational test phase to ensure the Sapphire lens does not negatively affect system effectiveness.
- COTF conducted all testing in accordance with the DOT&E-approved Test and Evaluation Master Plan and test plan.

Assessment

- Preliminary developmental test results using the new Sapphire lens indicate highly comparable sensor detection ranges to the previous material.
- The Sapphire material is expected to provide improved reliability in harsh environments during its intended service life. Laboratory environmental testing and flight test results demonstrated Sapphire performance met system-level requirements. However, due to limited flight testing, data are currently insufficient to assess the reliability of the new lens material.
- Operational test results showed the DAMTC LJDAM to be operationally effective in the self-lasing mode against targets that both moved and maneuvered during weapon flight. The DAMTC LJDAM's demonstrated accuracy was 5.8 meters, meeting the 6-meter accuracy requirement. Accuracy using the buddy-lasing mode was poor; however, the range restrictions and target limitations that prevailed during the four buddy-lasing weapon deliveries (and not present during the self-lasing deliveries) are believed to have contributed to the poor results. Demonstrated accuracy is sufficient to assure lethal effects against a DAMTC LJDAM maneuvering vehicle or stationary targets.
- Operational test results showed the DAMTC LJDAM to be operationally suitable. Using both operational test and integrated test phase weapons to estimate reliability resulted in a material reliability of 98 percent (46 of 47), exceeding the 90 percent requirement. The only hardware failure was a live weapon that did not detonate upon impact. An overall system reliability of 77 percent is the result of three different operator error failures and a single large miss distance of unknown origin. It should be noted that there is not a requirement specified for system reliability.
- Operational testing highlighted two deficiencies related to human factors. The first is the dense wiring inside the tail-kit of the LJDAM weapons that makes verifying fuze arming and function settings extremely difficult, especially at night. The umbilical wire bundles result in a very crowded tail compartment making it difficult to read the settings. Workarounds were all deemed unacceptable because they either prevent the aircrew from positively confirming proper fuze settings or interfere with the configuration of the original assembly of a live weapon.
- The second human factors deficiency is the high cockpit workload associated with delivering a DAMTC LJDAM, though this is comparable with the high workloads found with other laser-guided weapons. Some reduction should be achievable through aircraft Operational Flight Program improvements but targeting pod limitations appear to drive most of the inherent workload.

Recommendations

- Status of Previous Recommendations. The Navy completed the FY11 recommendation.
- FY12 Recommendations. The Navy should:
  1. Conduct additional testing using buddy-lasing from rear aspect geometries to distinguish between the effects of the range restrictions and target limitations and the use of the buddy-lasing tactic on the DAMTC LJDAM's accuracy.
  2. Re-design the wiring bundle in the weapon's tail compartment to enable an accurate visual pre-flight check of the weapon's fuze settings.

E-2D Advanced Hawkeye

Executive Summary

- E-2D IOT&E occurred from February to September 2012. The Navy plans to seek a Full-Rate Production decision from USD(AT&L) in January 2013.
- IOT&E included over 600 flight hours in overland, littoral, and over water environments. During testing, the E-2D tracked drone and traditional fighter-size aircraft targets. The test squadron embarked aircraft aboard a Navy aircraft carrier for at-sea testing, including carrier suitability, interoperability, and supportability.
- The Navy's Cooperative Engagement Capability (CEC) was supposed to complete follow-on testing in conjunction with the E-2D IOT&E; however, CEC developmental delays forced the de-coupling of these two events. As such, during IOT&E the Navy did not test the operationally representative software configuration of the CEC system in the E-2D.
- IOT&E was adequate to assess the E-2D Advanced Hawkeye's Air-to-Air and Strike Warfare mission performance.
- E-2D demonstrated improved surveillance capabilities relative to the E-2C. Test aircrews identified performance shortfalls with operator workload in dynamic, complex, high-target density environments.
- DOT&E was unable to assess during IOT&E the final E-2D CEC system configuration performance – a critical enabler for the Theater Air and Missile Defense (TAMD) mission.
- The E-2D Advanced Hawkeye demonstrated the ability to track cruise missile-sized targets during developmental and operational testing. While the system provided improved overland performance, the Navy needs to continue development efforts to provide a robust capability in all overland environments.
- Based on IOT&E reliability and availability data, DOT&E has identified shortfalls on some radar reliability and weapon system availability metrics, as well as immature training systems.

System

- The E-2D Advanced Hawkeye is a carrier-based Airborne Early Warning and Command and Control aircraft.
- Significant changes to this variant of the E-2 include upgraded engines to provide increased electrical power and cooling relative to current E-2C aircraft; a strengthened fuselage to support increased aircraft weight; replacement of the radar system, the communications suite, and the mission computer; and the incorporation of an all-glass cockpit, which permits the co-pilot to act as a tactical fourth operator in support of the system operators in the rear of the aircraft.

- The radar upgrade replaces the E-2C mechanically scanned radar with a phased-array radar that has combined mechanical and electronic scan capabilities.
- The upgraded radar is intended to provide significant improvement in Hawkeye littoral and overland detection performance and TAMD capabilities.
- The total E-2D Advanced Hawkeye system includes all simulators, interactive computer media, and documentation to conduct maintenance, as well as aircrew shore-based initial and follow-on training.

Mission

The Combatant Commander, whether operating from the aircraft carrier or from land, will use the E-2D Advanced Hawkeye to accomplish the following missions:

- Theater air and missile sensing and early warning
- Battlefield management, command, and control
- Acquisition, tracking, and targeting of surface warfare contacts
- Surveillance of littoral area objectives and targets
- Tracking of strike warfare assets

Major Contractor

Northrop Grumman Aerospace Systems – Bethpage, New York

Activity

- The Navy conducted the E-2D IOT&E from February to September 2012 in accordance with the DOT&E-approved Test and Evaluation Master Plan and test plan. The Navy plans to seek a Full-Rate Production decision from USD(AT&L) in 2QFY13.
- IOT&E testing included over 600 flight hours in overland, littoral, and over water environments. During testing, the E-2D tracked drone and traditional fighter-size aircraft targets. The test squadron conducted over 200 tracking events to assess Air-to-Air and Strike Warfare mission performance.
- The test squadron embarked aircraft aboard a Navy aircraft carrier for at-sea testing, including carrier suitability, interoperability, and supportability. This testing included operations from the aircraft carrier in support of a Joint Task

Force-level exercise as well as additional interoperability testing during Carrier Strike Group certification training, which involved all current carrier air wing capable aircraft. The test squadron conducted E-2D operations while participating in joint Large Force Exercises at Nellis AFB, Nevada, and Fallon Naval Air Station, Nevada. Additionally, the test squadron conducted over-water TAMD tracking exercises operating with Navy ships off the California coast.

- The Navy's CEC program planned to complete follow-on testing in conjunction with the E-2D IOT&E; however, CEC developmental delays forced the de-coupling of these two events. As such, during IOT&E the Navy did not test the operationally representative software configuration of the CEC system in the E-2D. The Navy addressed the flaws in the CEC system during the summer of 2012 with new system software loads for both the E-2D mission system and the CEC system and entered follow-on test for the CEC system in October 2012.

Assessment

- IOT&E was adequate to assess the E-2D Advanced Hawkeye's legacy mission performance. DOT&E expects to publish a report assessing the E-2D IOT&E performance in January 2013.
- E-2D was found to have improved surveillance capabilities relative to the E-2C. Test aircrews identified performance shortfalls with operator workload in dynamic, high-target density environments where the E-2D mission system erroneously swapped identification labels for crossing/closely-spaced aircraft tracks. Subsequently, the tracks required manual aircrew re-labeling in the mission system, which can lead to operator overload and loss of situational awareness.
- DOT&E was unable to assess the final E-2D CEC system configuration performance – a critical enabler for the TAMD mission. The TAMD mission, which is the primary reason the E-2D is being procured, will not be fully accessible until the CEC system is successfully tested and end-to-end TAMD testing is completed in the 2015 timeframe, shortly before the E-2D Initial Operational Capability declaration.
- The E-2D Advanced Hawkeye demonstrated the ability to track cruise missile-sized targets during developmental and operational testing. While the system provided improved overland performance, the Navy needs to continue radar and mission system development efforts to provide a robust capability in all overland environments.
- With the exception of CEC testing still in progress, E-2D voice and datalink communications match those of E-2C. The E-2D has the same Passive Detection System found in the E-2C. DOT&E assesses this capability as matching that of the current E-2C.
- The E-2D mission planning system, the Joint Mission Planning System (JMPS), is not currently effective. Operators use the JMPS to provide a means of importing mission-planning data into the E-2D mission computer for use during flight. There are JMPS shortcomings in reliability and usability causing the mission-planning process to be cumbersome and time-consuming. Additionally, there is a deficiency with JMPS loading the proper network configuration data for some Link 16 networks.
- Based on IOT&E reliability and availability data, DOT&E has identified shortfalls on some radar reliability and weapon system availability metrics. E-2D maintainability had no significant shortfalls in on-aircraft maintenance procedures, documentation, or support equipment. However, the maintenance training system for the E-2D will not be available until July 2013 due to prior acquisition decisions. The lack of a maintenance training system precludes a full assessment of the maintainability of the E-2D system.
- DOT&E could not assess aircrew training due to the non-availability of the E-2D integrated simulator, which will be used for shore-based initial and follow-on training, as well as aircrew tactical and carrier operating procedures proficiency.
- The E-2D aircraft performed nominally during at-sea operations. The current E-2C system operates in a four aircraft-per-squadron configuration as opposed to the E-2D, which the Navy plans to operate in a five aircraft-per-squadron configuration. The E-2D at-sea testing did not demonstrate fully the ability to logistically support the proposed five-aircraft E-2D squadron in the aircraft carrier environment. The limited number of at-sea sorties and the current limited spare parts support for E-2D precluded a full at-sea logistics supportability assessment of the five-aircraft E-2D squadron concept.

Recommendations

- Status of Previous Recommendations. The Navy continues efforts to address CEC and radar performance improvements as recommended in FY11. These efforts are critical to achieving the 2015 E-2D Initial Operational Capability and full TAMD capability.
- FY12 Recommendations.
  1. The Navy should continue to improve E-2D CEC performance following completion of the E-2D CEC follow-on test in January 2013.
  2. The E-2D program should investigate potential radar and mission system performance upgrades to improve system performance in the challenging overland arena.
  3. The E-2D program should resolve the mission system track re-labeling deficiency.
  4. The E-2D program should work with the JMPS Program Office to provide for E-2D aircrews an effective mission planning system.
  5. The E-2D program should aggressively focus on implementing the full logistics posture to support the E-2D five-aircraft squadron concept in the aircraft carrier environment.
  6. The E-2D Program Office should continue to improve radar and overall weapon system reliability and availability.

Enhanced Combat Helmet (ECH)

Executive Summary

- The Enhanced Combat Helmet (ECH) successfully met its ballistic and non-ballistic requirements during its First Article Test (FAT). However, while the ECH protects against perforation by the specified small arms threat, it does not provide a significant overall improvement in operational capability over currently fielded helmets against that threat. The ECH provides improved fragmentation protection compared to the fielded Advanced Combat Helmet and the Light Weight Helmet (LWH).
- Subsequent to FAT, during Engineering Change Proposal (ECP) testing of helmets manufactured using new machinery and tooling intended to provide increased helmet production capacity, the ECH experienced unexpected ballistic failures.
- Ceradyne (the manufacturer) indicated it had identified the reasons for these ballistic failures and implemented corrective actions. The ECH Program Office conducted additional testing to verify the effectiveness of Ceradyne's corrective actions. The ECH continued to experience unexpected ballistic failures during this testing.
- The ECH Program Office and Ceradyne continue to investigate the reasons for the ballistic failures.
- The ECH Program Office has delayed production and fielding of the ECH pending identification and correction of the reasons for the ballistic failures. The ECH Program Office projects testing to determine the effectiveness of corrective actions will begin in early 2013.

System

- The Marine Corps developed the ECH in response to a 2009 Urgent Statement of Need to produce a helmet that provides ballistic protection from energetic fragments and selected small arms ammunition, yet maintains all other characteristics of the Marine Corps' LWH and the Army's Advanced Combat Helmet (ACH).
- The ECH is compatible with and is typically worn in conjunction with other components of infantry combat equipment such as body armor systems, protective goggles, night vision equipment, and a camouflage fabric helmet cover. This new helmet is intended to provide Marines and Soldiers improved protection compared to the currently fielded LWH and ACH.

- The ECH consists of a ballistic protective shell, a pad suspension system, and a 4-point chin strap/nape strap retention system. Unlike the ACH and LWH helmets, which are constructed with aramid fibers, the ECH is constructed using ultra-high-molecular-weight polyethylene fibers.

Mission

Forces equipped with the ECH will rely on the helmet to provide ballistic protection from selected small arms ammunition and fragmentation when engaged with enemy combatants during tactical operations in accordance with applicable tactics, techniques, and procedures.

Major Contractor

Ceradyne, Inc. – Costa Mesa, California

Activity

- The Marine Corps conducted FAT II during November and December 2011 in accordance with the DOT&E-approved test plan. Following successful completion of this FAT, the Marine Corps conducted Full-Up System-Level live fire tests against both direct and indirect fire threats between December 2011 and February 2012.
- In April 2012, the ECH Program Office began testing ECPs to assess if helmets produced using new machinery, tooling,

or hardware (necessary to expand ECH production capability) continued to meet performance requirements prior to incorporating these new items into the production process.
- Due to unexpected ballistic failures during ECP testing, Ceradyne began an analysis of the causes for the failures, as well as actions required to correct the reasons for the failures. Ceradyne implemented corrective actions it thought would be effective and submitted newly-manufactured helmets for testing that began in late June 2012. The ECH Program Office designed the testing to verify that the corrective actions addressed the reasons for the ballistic failures, and that the helmets met ballistic requirements. However, the helmet continued to experience ballistic failures during this verification testing.
- In July 2012, the ECH Program Office assembled a team to assist Ceradyne with the subsequent failure analysis. Both the ECH Program Office and Ceradyne continue to conduct root cause analysis to determine the reasons for the ballistic failures.
- The ECH Program Office currently projects testing will begin in early 2013 to verify Ceradyne has corrected the reasons for the ballistic failures and that the helmets continue to meet requirements.

Assessment

- Although the ECH protects against perforation by the specified small arms threat, it does not provide a significant overall improvement in operational capability over currently fielded helmets against that threat. It is unlikely to provide meaningful protection against this small arms threat over a significant portion of the threat's effective range. However, the ECH does provide improved penetration protection against fragments relative to currently fielded helmets. The ECH met all ballistic performance requirements.
- In stopping high-energy threats, the helmet absorbs the projectile energy by deforming inward toward the skull. It is unknown, definitively, whether the ECH provides protection against injury when the deforming helmet impacts the head. There is, however, reason to be concerned because the deformation induced by the impact of a non-perforating small arms threat exceeds accepted deformation standards across most of the threat's effective range.
- There are no definitive medical criteria or analytic methods to correlate the extent of helmet deformation to injury. However, according to the Armed Forces Medical Examiner's Office, even absent medical studies definitively correlating helmet deformation with specific injury, the deformation observed during testing represents significant blunt force and/or penetrating trauma to the head that could be lethal.
- While the ECH met the stated resistance to the perforation requirement against the specified small arms threat, one helmet shot location was more prone to small arms perforations than others. The ECH Program Office plans to implement an ECP to address this problem.
- Structural degradation as a result of prolonged temperature and humidity exposure may be a concern for the ECH. Published data document the degradation of ballistic performance in ultra-high-molecular-weight polyethylene materials, but the long-term performance of the ECH's specific ballistic material is unknown.
- The ECH Program Office has contracted to procure ECHs in production lots of mixed helmet sizes. There is no assurance that testing of these mixed lots will include sufficient numbers of the individual sizes produced within a lot to draw valid conclusions from the test results.

Recommendations

- Status of Previous Recommendations. There were no previous recommendations for this program.
- FY12 Recommendations. The ECH Program Office should:
  1. Conduct adequate testing to ensure the failures observed during ECP testing are identified and corrected. In addition, they should test and implement the planned ECP to address small arms perforation concerns at the one shot location. Until the ECP addressing the small arms perforation concern is implemented, the ECH Program Office should conduct adequate lot acceptance testing to ensure the helmet provides adequate protection from small arms perforation at all impact locations.
  2. Carefully monitor the results of lot acceptance testing when ECH production begins for indications of variations in the manufacturing process that could affect the ECH's ballistic protection.
  3. Improve ECH protection by reducing the amount of helmet deformation caused by non-perforating small arms impacts, as improvements in materials and manufacturing processes permit.
  4. Conduct testing to determine whether long-term exposure to elevated temperatures and humidity degrades ECH ballistic performance.
  5. Procure ECH in production lots of a single helmet size to ensure adequate lot acceptance testing.

F/A-18E/F Super Hornet and EA-18G Growler

Executive Summary

- In FY11, the Navy conducted Software Qualification Testing (SQT) of System Configuration Set (SCS) H6E for F/A-18E/F Super Hornet and EA-18G Growler aircraft, SQT of SCS 23X for early-model F/A-18E/F aircraft, and a second FOT&E period for the APG-79 Active Electronically Scanned Array (AESA) radar. DOT&E issued individual classified reports on this testing for both F/A-18E/F and EA-18G in FY12.
- The APG-79 AESA radar provides improved performance relative to the legacy APG-73 radar; however, operational testing did not demonstrate a statistically significant difference in mission accomplishment between F/A-18E/F aircraft equipped with AESA and those equipped with the legacy radar.
- While SCSs H6E and 23X demonstrate acceptable suitability, the AESA radar's reliability continues to suffer from software instability. The radar's failure to meet reliability requirements and poor built-in test (BIT) performance remain as shortfalls from previous test and evaluation periods.
- Overall, the F/A-18E/F Super Hornet weapon system is operationally effective and suitable for most threat environments. However, the platform is not operationally effective for use in certain threat environments, the specifics of which are addressed in the DOT&E FY12 classified report.
- The EA-18G Growler weapon system is operationally effective and operationally suitable.
- The Navy is conducting F/A-18E/F and EA-18G SCS H8E SQT in two phases. Phase I operational testing commenced in 4QFY12 and is scheduled to complete in 1QFY13. The Navy expects to conduct Phase II testing during 2Q – 3QFY13. DOT&E will issue a single report covering both H8E phases after the completion of Phase II in 4QFY13.

System

F/A-18E/F Super Hornet

- The Super Hornet is the Navy's premier strike-fighter aircraft that replaces earlier F/A-18 variants in carrier air wings. The F/A-18E is a single-seat aircraft while the F model has two seats.
- F/A-18E/F Lot 26+ aircraft provide functionality essential for integrating all Super Hornet Block 2 hardware upgrades, which include:
  - Single pass multiple targeting for GPS-guided weapons
  - Use of off-board target designation
  - Improved datalink target coordination precision
  - Implementation of air-to-ground target points

- Additional systems include:
  - APG-73 or APG-79 radar
  - Advanced Targeting and Designation Forward-Looking Infrared System
  - AIM-9 infrared-guided missiles and AIM-120 and AIM-7 radar-guided missiles
  - Shared Reconnaissance Pod
  - Multi-functional Information Distribution System for Link 16 tactical datalink connectivity
  - Joint Helmet Mounted Cueing System
  - Integrated Defensive Electronic Countermeasures

EA-18G Growler

- The Growler is the Navy's land- and carrier-based, radar and communication jamming aircraft.
- The two-seat EA-18G replaces the four-seat EA-6B. The new ALQ-218 receiver, improved connectivity, and linked displays are the primary design features implemented to reduce the operator workload in support of the EA-18G's two-person crew.
- The Airborne Electronic Attack (AEA) system includes:
  - Modified EA-6B Improved Capability III ALQ-218 receiver system
  - Advanced crew station
  - Legacy ALQ-99 jamming pods
  - Communication Countermeasures Set System
  - Expanded digital Link 16 communications network
  - Electronic Attack Unit
  - Interference Cancellation System that supports communications while jamming

- Satellite receive capability via the Multi-mission Advanced Tactical Terminal
- Additional systems include:
  - APG-79 AESA radar
  - Joint Helmet Mounted Cueing System
  - High-speed Anti-Radiation Missile
  - AIM-120 radar-guided missiles

System Configuration Set (SCS) Software

- Growler and Super Hornet aircraft employ SCS operational software to enable major combat capabilities. All EA-18Gs and Block 2 F/A-18s (production Lot 26 and beyond) use high-order language or "H-series" software, while F/A-18E/F prior to Lot 26 and all legacy F/A-18 A/B/C/D aircraft use "X-series" software. The current fleet-release software are H6E and 23X, respectively.

Mission

- Combatant Commanders use the F/A-18E/F to:
  - Conduct offensive and defensive air combat missions
  - Attack ground targets with most of the U.S. inventory of precision and non-precision weapon stores
  - Provide in-flight refueling for other tactical aircraft
  - Provide the fleet with an organic tactical reconnaissance capability
- Combatant Commanders use the EA-18G to:
  - Support friendly air, ground, and sea operations by countering enemy radar and communications
  - Jam integrated air defense systems
  - Support non-integrated air defense missions and emerging non-lethal target sets
  - Enhance crew situational awareness and mission management
  - Enhance connectivity to national, theater, and tactical strike assets
  - Provide enhanced lethal suppression through accurate High-speed Anti-Radiation Missile targeting
  - Provide the EA-18G crew air-to-air self-protection with the AIM-120

Major Contractor

The Boeing Company, Integrated Defense Systems – St. Louis, Missouri

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Activity

- DOT&E reported on APG-79 radar IOT&E in FY07, assessing it as not operationally effective or suitable due to significant deficiencies in tactical performance, reliability, and BIT functionality.
- The Navy conducted APG-79 radar FOT&E in FY09 in conjunction with SCS H4E SQT. The Navy's Commander, Operational Test and Evaluation Force subsequently reported that significant deficiencies remained for both APG-79 AESA performance and suitability; DOT&E concurred with this assessment.
- Concurrent with SQT for SCSs H6E and 23X, the Navy conducted a second APG-79 radar FOT&E period in FY11. The Navy conducted the testing in accordance with the DOT&E-approved Test and Evaluation Master Plan (TEMP) and test plan. DOT&E issued a classified report on this testing in FY12; finding that the Super Hornet made incremental improvements, but still retained important deficiencies.
- The Navy is conducting F/A-18E/F and EA-18G SCS H8E SQT in two phases. Phase I operational testing was originally scheduled for 1QFY12, but due to multiple software anomalies during developmental testing, the Navy postponed the Operational Test Readiness Review until 3QFY12. H8E Phase I operational testing commenced in 4QFY12 and is scheduled to complete in 1QFY13. The Navy is conducting the testing in accordance with the DOT&E-approved TEMP and test plan.
- The Navy expects to conduct H8E Phase II operational testing during 2Q – 3QFY13.
- SCS H8E testing does not include an end-to-end multi-AIM-120 missile shot. This capability is a Navy operational requirement not previously demonstrated or successfully tested. The Navy tentatively plans to conduct a multi-missile shot in conjunction with SCS H12E testing.

Assessment

- The APG-79 AESA radar demonstrated marginal improvements since the previous FOT&E period and provides improved performance relative to the legacy APG-73 radar. However, operational testing does not demonstrate a statistically significant difference in mission accomplishment between F/A-18E/F aircraft equipped with AESA and those equipped with the legacy radar.
- Full development of AESA electronic warfare capability remains deferred to later software builds.
- While SCSs H6E and 23X demonstrate acceptable suitability, the AESA radar's reliability continues to suffer from software instability despite software upgrades. The radar's failure to meet reliability requirements and poor BIT performance remain as shortfalls from previous test and evaluation periods.
- Overall, the F/A-18E/F Super Hornet weapon system is operationally effective and suitable for most threat environments. However, the platform is not operationally effective for use in certain threat environments, the details of which are addressed in DOT&E's classified report.
- The EA-18G Growler weapons system is operationally effective and operationally suitable.
- DOT&E will report on Super Hornet and Growler SCS H8E capability improvements after both Phase I and II operational testing are complete in 4QFY13.

Recommendations

- Status of Previous Recommendations.
  - The Navy made minimal progress addressing FY11 F/A-18E/F recommendations. Recommendations to continue to improve APG-79 AESA reliability and BIT functionality, to conduct an operationally representative end-to-end missile shot to demonstrate APG-79 radar and current SCS ability to support multi-AIM-120 engagement, and to develop and characterize the APG-79 AESA's full electronic warfare capability remain valid.
  - The Navy satisfactorily addressed three of seven FY11 EA-18G recommendations. Recommendations to improve aircraft maintainability and BIT software maturity, to improve ALQ-218 and ALQ-99 maintenance documentation and diagnostic tools, and to assess the need for a more capable threat range at Whidbey Island, Washington, remain valid.
- FY12 Recommendations. None.

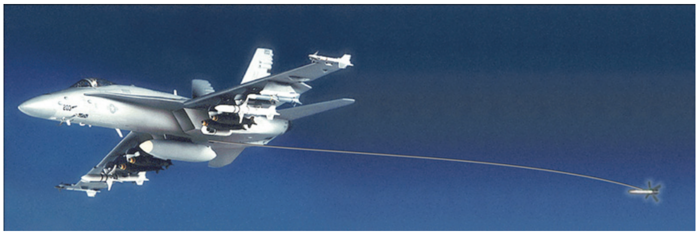
Integrated Defensive Electronic Countermeasures (IDECM)

Executive Summary

- DOT&E approved the classified Integrated Defensive Electronic Countermeasures (IDECM) Block IV (IB-4) Test and Evaluation Master Plan (TEMP) in January 2012.
- The Navy authorized the first lot buy of IB-4 systems in March 2012 following its In-Process Review (IPR) #3. At that time, DOT&E assessed that the system was nine months behind schedule and less mature than planned. No effectiveness or suitability results were available to support the lot production decision.
- Since IPR #3 in March 2012, the program has been delayed an additional three months and the operational assessment (OA) has been reduced in scope because of IB-4 software immaturity and unavailability of laboratory resources.
- The IB-4 OA began September 2012 and is expected to conclude by December 2012. It includes flight tests and a laboratory test. The Navy has made progress in hardware testing and software development, and is resolving deficiencies at an increasing rate since the IPR #3. However, the Navy continues to discover system deficiencies at a steady rate, and DOT&E anticipates that the program will need additional time to resolve system deficiencies, thus extending the test schedule.

System

- The IDECM system is a radio frequency, self-protection electronic countermeasure suite on F/A-18 aircraft. The system is comprised of onboard and off-board components. The onboard components receive and process radar signals and can employ onboard and/or off-board jamming components in response to identified threats.
- There are four IDECM variants: Block I (IB-1), Block II (IB-2), Block III (IB-3), and Block IV (IB-4). All four variants include an onboard radio frequency receiver and jammer.
  - IB-1 (fielded FY02) combined the legacy onboard receiver/jammer (ALQ-165) with the legacy (ALE-50) off-board towed decoy.



  - IB-2 (fielded FY04) combined the improved onboard receiver/jammer (ALQ-214) with the legacy (ALE-50) off-board towed decoy.
  - IB-3 (fielded FY11) combines the improved onboard receiver/jammer (ALQ-214) with the new (ALE-55) off-board fiber optic towed decoy that is more integrated with the ALQ-214.
  - IB-4 (currently in development) is intended to replace the onboard receiver/jammer (ALQ-214(V)3) with a lightweight, repackaged onboard jammer (ALQ-214(V)4 and ALQ-214(V)5).
- The F/A-18E/F installation includes off-board towed decoys. The F-18C/D installation includes only the onboard receiver/jammer components and not the towed decoy.

Mission

- Combatant Commanders will use IDECM to improve the survivability of Navy F/A-18 strike aircraft against radio frequency-guided threats while on air-to-air and air-to-ground missions.
- The Navy intends to use IB-3's and IB-4's complex jamming capabilities to increase survivability against modern radar guided threats.

Major Contractors

- ALE-55: BAE Systems – Nashua, New Hampshire
- ALQ-214: ITT Electronic Systems – Clifton, New Jersey
- ALE-50: Raytheon Electronic Warfare Systems – Goleta, California

Activity

IDECM Block III

- DOT&E completed its IDECM Block III IOT&E report in June 2011, assessing the system as operationally effective and operationally suitable for combat. The Navy authorized IDECM Block III full-rate production in July 2011.

IDECM Block IV

- Developmental laboratory testing began in September 2011 at the Navy's Advanced Weapons Laboratory system integration lab at China Lake, California, and the Navy's Electronic Combat System Evaluation Laboratory (ECSEL) at Point Mugu, California.

- DOT&E approved the classified IB-4 TEMP in January 2012.
- The Navy's Commander, Operational Test and Evaluation Force (COTF) completed a Developmental Test Assist assessment in February 2012, which consisted primarily of observations of contractor and Navy laboratory testing. COTF noted significant hardware, software, and compatibility shortfalls based on its observations (details are classified).
- The Navy approved the first lot production of IB-4 systems in March 2012.
- The Navy conducted developmental ground-mount open-air range testing at the Navy's Slate Range at China Lake, California, and at the Nevada Test and Training Range. The Navy began developmental risk reduction flight testing in May 2012 at China Lake, California.
- The Navy began IB-4 OA testing in September 2012, consisting of flight testing at the Electronic Combat Range in China Lake and laboratory testing at the ECSEL in Point Mugu. The OA was reduced in scope from what was originally described in the January 2012 TEMP. The Navy requested a delay in one of the planned laboratory tests to further mature IB-4 software, and a national priority Air Force program took precedence over IB-4 at one of the laboratory test facilities. DOT&E approved this reduction in scope. The Navy will complete the two deferred tests as described in the DOT&E-approved test plan prior to the start of FOT&E and DOT&E will issue an FOT&E report.
- The Navy plans to complete a redesign of the IDECM receiver near the end of the FOT&E. The Program Office expects the redesigned receiver's effect on system performance to be minimal; DOT&E will work with the Program Office to determine the scope of any necessary additional testing.
- With each future IPR, beginning with IPR #3 (March 2012), the Navy is authorizing purchases of the ALQ-214(V)4 for the F/A-18 E/F and the ALQ-214(V)5 for the F/A-18 C/D.

Assessment

- At the IPR #3, IB-4 was 9 months behind the schedule the Navy presented at the hardware critical design review 30 months earlier. The Navy had not completed several key hardware tests and had not started system effectiveness and suitability testing, which led to a less informed IPR #3. Deficiency report submissions from developmental testing were continuing at a steady rate, with the number of unresolved deficiencies outpacing the number of resolved deficiencies, showing lack of system maturity.
- The Navy has made progress in hardware testing and software development, and is resolving deficiencies at an increasing rate since IPR #3. However, the Navy continues to discover system deficiencies at a steady rate, and DOT&E anticipates that the program will need additional time to resolve system deficiencies, thus extending the test schedule. This will require the Navy to either postpone conducting the next IPR and lot production decision (currently scheduled for March 2013) or again make a lot production decision with much less information than originally intended.
- DOT&E assessed system maturity at the start of the OA test as less than the program originally planned. No suitability data and limited effectiveness data were available to support the OA test readiness review, and therefore the program assumed increased risk of inadequate system performance during the OA.
- The Navy has significantly reduced the time period between the completion of all testing planned for the OA and FOT&E, thus leaving little time to correct deficiencies found as a result of testing.

Recommendations

- Status of Previous Recommendations. The Navy has adequately addressed three of the nine IDECM-specific recommendations from FY11. The Navy has partially addressed an additional three of the nine recommendations and further activity to resolve them is ongoing. The three recommendations that may require material solutions and/or further Research and Development Test and Evaluation have not yet been addressed and are repeated below. One electronic warfare recommendation that was not program-specific is also repeated below.

IDECM System

1. The Navy should restructure and reorganize the complex and poorly organized IDECM system software code. This will minimize potential software problems yet to be discovered and simplify future modifications.
2. The Navy should develop hardware and/or software changes to provide pilots with correct indications of whether a decoy was completely severed. This recommendation does not apply to the F/A-18 C/D installation since that installation does not include a towed decoy.
3. The Navy should investigate the effects of IDECM on threat missile fuses.

Electronic Warfare Warfighting Improvements

4. In coordination with the Defense Intelligence Agency, the Navy should update the threat lethal radii and/or the evaluation processes that are used to determine whether simulated shots are hits or misses.

- FY12 Recommendations. None.

Joint Standoff Weapon (JSOW)

Executive Summary

- The Navy completed developmental testing and initiated integrated testing of the AGM-154C-1 Joint Standoff Weapon (JSOW) variant during FY12. The JSOW C-1 integrated testing completed in early FY13, with operational testing to begin in mid-FY13.
- Preliminary results to date indicate that weapon impact accuracy for moving maritime targets is well within the accuracy requirement value, and accuracy performance against stationary land targets has been maintained.
- Preliminary results to date indicate that the JSOW C-1 Mean Flight Hours Between Operational Mission Failure (MFHBOMF) is well below the requirement value, primarily the result of software-driven problems. Another concern is the excessively complicated pilot-vehicle interface (PVI), which could prevent successful mission execution.
- Planned updates to the software to address these problems may invalidate use of some integrated test data for DOT&E's operational evaluation of JSOW C-1.

System

- The AGM-154 JSOW family uses a common and modular weapon body capable of carrying various payloads. The JSOW is a 1,000-pound class, air-to-surface glide bomb intended to provide low observable, standoff precision engagement with launch and leave capability. All variants employ a tightly coupled GPS/Inertial Navigation System.
- AGM-154A (JSOW A) payload consists of 145 BLU-97/B combined effects submunitions.
- AGM-154C (JSOW C) utilizes an imaging infrared seeker and its payload consists of an augmenting charge and a follow-through bomb that can be set to detonate both warheads simultaneously or sequentially.
- AGM-154A and AGM-154C are fielded weapons, and are no longer under DOT&E oversight. AGM-154C-1 (JSOW C-1) adds moving maritime target capability and the two-way strike common weapon datalink to the baseline AGM-154C weapon.

Mission

- Combatant Commanders use JSOW A to conduct pre-planned attacks on soft point and area targets such as air defense sites, parked aircraft, airfield and port facilities, command and control antennas, stationary light vehicles, trucks, artillery, and refinery components.
- Combatant Commanders use JSOW C to conduct pre-planned attacks on point targets vulnerable to blast and fragmentation effects and point targets vulnerable to penetration such as industrial facilities, logistical systems, and hardened facilities.
- Units will use JSOW C-1 to conduct attacks against moving maritime targets and have the ability to retarget weapons post-launch. JSOW C-1 will retain the JSOW C legacy capability against stationary land targets.

Major Contractor

Raytheon Company, Missile Systems – Tucson, Arizona

Activity

- The Navy conducted developmental and integrated testing in accordance with a DOT&E-approved Test and Evaluation Master Plan for the JSOW C-1.
- The Navy completed the developmental test phase in FY12 with the release of the second of two planned free flight weapon drops against moving maritime targets.
- The Navy completed the four planned integrated test free flight weapon drops in 4QFY12 through 1QFY13. Two were against a moving maritime target and two regression tests of JSOW C legacy capability against a stationary land target.
- Results from the developmental and integrated testing will support an Operational Test Readiness Review (OTRR) in 2QFY13. The Navy has scheduled JSOW C-1 operational testing for FY13 following the OTRR.

Assessment

- Navy testing of JSOW C-1 is ongoing. Preliminary results to date indicate:
  - Weapon impact accuracy for moving maritime targets is well within the accuracy requirement value and accuracy performance against stationary land targets has been maintained.
  - JSOW C-1 MFHBOMF is well below the requirement value. This is primarily the result of software-driven problems. Achieving adequate assessment of MFHBOMF during operational testing is an area of high risk.
  - Excessively complicated PVI that could prevent successful mission execution is an area of high risk during operational testing.
- Planned updates to the JSOW software to address these problems may invalidate use of some developmental and integrated test data for DOT&E's operational evaluation of JSOW C-1.

Recommendations

- Status of Previous Recommendations. The Navy has satisfactorily addressed previous recommendations for JSOW A and C. There are no previous recommendations for JSOW C-1 since it is a new variant of the AGM-154.
- FY12 Recommendation.
  1. Before proceeding to JSOW C-1 operational testing, the Navy should verify that newly incorporated software updates adequately reduce software-driven failures and that PVI complexity have been mitigated sufficiently to permit successful mission execution.

Light Armored Vehicle (LAV) Upgrade

Executive Summary

- The Marine Corps has developed a special purpose kit to improve protection from under-vehicle attacks. This kit (known as the D-Kit) is designed to work with the Ballistic Protection Upgrade Package (BPUP) and is installed at the discretion of the operational commander.
- The Marine Corps completed eight system-level underbody blast tests in March 2012 at Aberdeen Test Center, Maryland; the data indicate that the D-kit increases crew protection.

System

- The Family of Light Armored Vehicles (LAV) shares a common base platform configuration (eight-wheels, armored hull, suspension, power plant, drive train, and auxiliary automotive subsystem) among eight Mission Role Variants (MRVs). The LAV-25 personnel carrier is the predominant MRV.
- The Marine Corps initiated a Service Life Extension Program in FY05 primarily to address obsolescence deficiencies. The Marine Corps undertook the Survivability Upgrade I program based on an Urgent Need Statement from the operating forces. This upgrade became the LAV A2 configuration standard, and involved developing and installing a BPUP, power pack enhancements, upgraded suspension, and other modifications.
- The BPUP system consists of three kits, two of which provide additional protection against threats, while the third provides an internal and external stowage system.
- In 2007, the Program Management LAV Office internally designed an underbody kit (known as a D-Kit) that can be incorporated to counteract under-vehicle strikes. The D-kit has been fielded since 2009.
- The LAV A2 D-Kit is designed to work with the previously installed BPUP system and is a special purpose mission kit used in theater at the discretion of the operational commander. The BPUP provides armor protection to the sides and front of the vehicle, whereas the D-Kit provides additional armor protection with a V-shaped hull attachment under the vehicle.

LAV-25 A2 Variant

Mission

Marine Corps commanders will use LAVs to provide combined arms reconnaissance, security missions, and mobile electronic support.

Major Contractors

- General Dynamics Land Systems – Canada
- Conversion of a LAV A1 to a LAV A2 is conducted at Marine Corps Logistics Base – Albany, Georgia, and Marine Corps Logistics Base –Barstow, California

Activity

- Follow-on System-Level Underbody Testing completed in March 2012 at Aberdeen Test Center, Maryland, in accordance with the DOT&E-approved LFT&E Strategy and the Event Design Plan. The LAV Program Office provided two fully-armored LAV-25 A2 assets to test and characterize the force protection capabilities and vehicle vulnerability against underbody blast threats. The test also included Mine Resistant Ambush Protected All-Terrain Vehicle level threats, as well as threshold threats, and a single test without the D-Kit.
- DOT&E will provide a classified LFT&E report to Congress.

Assessment

- Analysis of data after completion of the Follow-on System Level Underbody Testing confirms DOT&E's assessment of emerging results from FY11.
- Testing and analysis confirm that the LAV-25 A2 D-Kit increases crew protection against some under-vehicle mine and IED strikes. The details are available in the December 2012 classified DOT&E LFT&E report.
- The location of the LAV-25 A2 fuel cell, which is centered under the rear of the vehicle, increases crew vulnerability to some under-vehicle threats.

Recommendations

- Status of Previous Recommendations. The Marine Corps is addressing the previous two recommendations through funding efforts in the Program Objective Memorandum for FY14, and is pursuing additional LAV survivability upgrades (such as blast mitigation seats, 5-point harness seat belts, and advanced suspension designs) with development and procurement slated for the FY17-20 timeframe. Additionally, the Marine Corps is actively engaged in the recommendation to consider relocating the fuel cell of the LAV-25 A2, by utilizing the LAV MRV fuel cell relocation program as a pre-cursor to a LAV-25 A2 fuel cell relocation program. The results of the MRV fuel cell relocation program will aid the program manager with engineering analysis for the subsequent LAV-25 A2 fuel cell relocation.
- FY12 Recommendations. None.

Littoral Combat Ship (LCS)

LCS 1

LCS 2

Executive Summary

- The draft revision of the Littoral Combat Ship (LCS) Test and Evaluation Master Plan (TEMP) currently being proposed by the Navy will require additional revisions to be approved by DOT&E. In particular, the TEMP must incorporate phased operational testing of all increments of mission module capability to be deployed for use in combat.
- The Navy commenced a Quick Reaction Assessment (QRA) of the gun systems on LCS 1 in June 2012. Results from the QRA revealed performance, reliability, and operator training deficiencies for both the 30 mm and 57 mm guns.
- The Navy conducted testing of the MH-60S Block 2 Airborne Mine Countermeasures (AMCM) System, which is intended to support LCS mine countermeasures. Testing indicated shortfalls in performance:
  - The Navy determined the MH-60S helicopter cannot safely tow the AN/AQS-20A Sonar Mine Detecting Set (AQS-20A) or the Organic Airborne Sweep and Influence System (OASIS) because the helicopter is underpowered for these operations. The MH-60S helicopter will no longer be assigned these missions operating from any ship, including LCS.
  - Preliminary evaluation of test data collected during operational assessment (OA) of the MH-60S Block 2 Airborne Laser Mine Detection System (ALMDS) indicates that the system does not meet Navy requirements for False Classification Density and has low reliability.
- DOT&E agreed to defer the Total Ship Survivability Trials (TSSTs) from LCS 1 and 2 to LCS 3 and 4, which affords the Navy time to complete pre-trial damage scenario analysis.
- DOT&E also agreed to defer the Shock Trials from LCS 3 and 4 to LCS 5 and 6, resulting in a one-year delay, due to significant seaframe and system design changes expected. LCS 5 and 6 will be most representative of the class for purposes of the Shock Trials.

System

- The LCS is designed to operate in the shallow waters of the littorals where larger ships cannot maneuver as well. It is intended to accommodate a variety of individual warfare systems (mission modules) assembled and integrated into interchangeable mission packages.
- The Navy currently plans to field Mine Countermeasure (MCM), Surface Warfare (SUW), and Anti-Submarine Warfare (ASW) mission packages.
- The Navy is procuring two ship (seaframe) variants:
  - USS *Freedom* (LCS 1, 3, 5, and follow-on ships) is a semi-planing monohull design constructed of steel (hull) and aluminum (deckhouse) with a combined diesel and gas turbine main propulsion system.
  - USS *Independence* (LCS 2, 4, 6, and follow-on ships) is an aluminum trimaran design driven by four independent steerable water jets.
- Common design specifications:
  - Sprint speed in excess of 40 knots, draft of less than 20 feet, and unrefueled range in excess of 3,500 nautical miles at 14 knots
  - Accommodations for up to 76 personnel (air detachment personnel, mission module personnel, and a core crew of no more than 40)
  - A Common Mission Package Computing Environment for mission package control
  - Hangars sized to embark MH-60R/S and Vertical Take-Off Unmanned Aerial Vehicles (VTUAVs)
  - 57 mm Bofors Mk 3 gun
- The designs have different core combat systems to provide command and control, situational awareness, and self defense against anti-ship cruise missiles and surface craft.
  - *Freedom* Variant: COMBATSS-21, an Aegis-based integrated combat weapons system with a TRS-3D air/surface search radar, Ship Self-Defense System Rolling Airframe Missile (RAM) system (one 21-cell launcher),

and a DORNA Electro-Optical/Infrared system for Mk 110 57 mm gun fire control.
  - *Independence* Variant: Integrated combat management system (derived from Dutch TACTICOS system) with a Sea Giraffe air/surface search radar, one RAM (11-cell) launcher integrated with the Close-In Weapons System (Mk 15) search and fire control radars (called SeaRAM), and Sea Star SAFIRE Electro-Optical/Infrared systems for 57 mm gun fire control.
- Multiple individual programs of record involving sensor and weapon systems and off-board vehicles make up the individual mission modules. Mission modules provide offensive capability.
  - SUW Mission Package:
    - Gun Mission Module (two Mk 46 30 mm guns) (Increment 1)
    - Aviation Module (embarked MH-60R and VTUAV) (Increment 1)
    - Maritime Security Module (small boats) (Increment 2)
    - Surface-to-Surface Missile system intended to provide limited "interim" SUW capability in response to an urgent operational need (Increment 3)
    - Longer range Surface-to-Surface Missile (Increment 4)
  - MCM Mission Package:
    - Remote Minehunting System (RMS), consisting of the Remote Multi-Mission Vehicle (RMMV) and the AQS-20A sonar system (Increment 1)
    - MH-60S Block 2A/B AMCM System, consisting of an AMCM system operator workstation, a tether system, and the two MCM systems currently under development – ALMDS for detection and classification of near-surface mines, and the Airborne Mine Neutralization System (AMNS) for identification and neutralization of in-volume and bottom mines (the AQS-20A sonar system and OASIS are no longer being developed for use in the AMCM System) (Increment 1)
    - AMNS Pre-Planned Product Improvement (P3I) Program for neutralization of near-surface mines and Coastal Battlefield Reconnaissance and Analysis Block I (COBRA Blk I) system for unmanned aerial tactical reconnaissance to detect and localize minelines and obstacles in the daylight in the beach zone and partially in the surf zone (Increment 2)
    - Unmanned Influence Sweep System (UISS) to activate acoustic-, magnetic-, and combined acoustic/magnetic-initiated volume and bottom mines in shallow water so they self-destruct (Increment 3)
    - COBRA Block II system, which has Block I capability with the addition of night-time minefield and obstacle detection capability and full detection capability in surf zone; and Knifefish Unmanned Undersea Vehicle, a self-propelled, untethered, autonomous underwater vehicle, employing a low-frequency broadband sonar sensor to detect, classify, and identify volume and bottom mines in shallow water (Increment 4)
  - ASW Mission Package:
    - Torpedo Defense and Countermeasures Module (Light Weight Tow torpedo countermeasure) (Increment 2)
    - ASW Escort Module (Multi-Function Towed Array and Variable Depth Sonar) (Increment 2)
    - Aviation Module (embarked MH-60R and two VTUAVs) (Increment 2)
- The Navy plans to acquire a total of 55 LCSs. In early FY11, the USD(AT&L) authorized the procurement of hulls 3 through 22 (10 of each ship design), subject to Congressional appropriations.

Mission
- The Maritime Component Commander will employ LCS to conduct MCM, ASW, or SUW tasks depending on the mission package fitted into the seaframe. With the Maritime Security Module, installed as part of the SUW mission package, the ship can conduct Visit, Board, Search, and Seizure maritime interception operations. Commanders can employ LCS in a maritime presence role in any configuration because of capabilities inherent to the seaframe.
- The Navy can employ LCS alone or in company with other ships. The Navy is still developing the concept of employment and operations for these ships in each of the mission areas.

Major Contractors
- *Freedom* Variant (LCS 1, 3, 5, 7, and follow-on ships)
  - Prime: Lockheed Martin Maritime Systems and Sensors – Washington, District of Columbia
  - Shipbuilder: Marinette Marine – Marinette, Wisconsin
- *Independence* Variant (LCS 2, 4, 6, 8, and follow-on ships)
  - Prime for LCS 2 and LCS 4: General Dynamics Corporation Marine Systems, Bath Iron Works – Bath, Maine
  - Prime for LCS 6, LCS 8, and follow-on ships: Austal USA – Mobile, Alabama
  - Shipbuilder: Austal USA – Mobile, Alabama
- Mission Packages
  - Future Mission Package Integration contract awarded to Northrop Grumman – Los Angeles, California

Activity

Seaframe

- *Freedom* Variant (LCS 1):
  - The Navy completed the first phase of the Post-Shakedown Availability (PSA), which commenced in 3QFY11, on LCS 1. During sea trials following this event, the ship developed a shaft seal leak and subsequently reentered dry-dock for six weeks to repair.
  - The Navy's Board of Inspection and Survey (INSURV) graded LCS 1 as fit for service during special trials in May 2012 following the emergent dry-docking.
  - The Navy continued developmental testing of the 57 mm gun system on LCS 1.
  - The Navy's Commander, Operational Test and Evaluation Force (COTF) commenced a QRA on LCS 1 in support of FY13 early deployment. Part I (57 mm gun assessment) of the QRA began in 3QFY12. Part II (Information Assurance and Maritime Interdiction Operations assessments) will take place on LCS 1 during 1QFY13.
  - The Navy started the second PSA in July 2012 on LCS 1 in San Diego, California.
- *Independence* Variant (LCS 2):
  - The Navy commissioned LCS 2 in January 2010 and began MCM mission module developmental testing in Mobile, Alabama, after commissioning.
  - LCS 2 departed the east coast and arrived in San Diego, California, in May 2012.
  - The Navy commenced the first phase of the nine-month PSA in September 2012 in San Diego, California.
- *Freedom* Variant (LCS 3):
  - INSURV evaluated LCS 3 as satisfactory during acceptance trials in April 2012.
  - The Navy commissioned LCS 3 in Galveston, Texas, in September 2012.

SUW Module

- COTF tested the 30 mm gun on LCS 1 during the QRA in June and July 2012 in accordance with the DOT&E-approved data collection plan. The Navy continued developmental testing of the 30 mm gun system on LCS 1.

MCM Module

- The Navy conducted testing of the MH-60S Block 2 AMCM System, which is intended to support LCS MCM.
  - COTF completed testing of the MH-60S Block 2A AMCM System with the AQS-20A sonar system in 4QFY11 in accordance with the DOT&E-approved test plan. DOT&E issued an OA report in June 2012.
  - COTF commenced Phase A (Shore-based and Training Phase) of the planned OA of the MH-60S Block 2 AMCM System with the ALMDS in 2QFY12; testing completed in 4QFY12, and was conducted in accordance with the DOT&E-approved test plan. DOT&E expects to issue a formal test report in 2QFY13. The Navy postponed conduct of Phase B (LCS Ship-based Phase) of the planned OA due to the unavailability of an LCS seaframe to facilitate conduct of MCM mission module testing. The Navy intends to conduct the LCS ship-based phase of the planned ALMDS and AMNS OAs in conjunction with the LCS Technical Evaluation scheduled to occur in FY14.
- The RMS program completed reliability growth testing (developmental testing) of RMMV version 4.1 in 1QFY12.
- The Navy commenced a ship-based phase of MCM mission module developmental testing (DT-B2) in 1QFY12; testing completed in 4QFY12.

LFT&E

- The Navy revised the survivability requirements for LCS 3 and beyond to describe the ships' survivability requirements in terms of class-specific LCS Vulnerability Levels:
  - LCS Vulnerability Level I – Operate emergency and damage control systems/equipment to provide for an orderly abandon ship.
  - LCS Vulnerability Level II – All of the capabilities of LCS Vulnerability Level I, plus the capability for mobility to exit the immediate area, electrical power and other required services to operate vital systems, exterior communications to support contact with the operational commander, and small-to-medium caliber weapons or equivalent capability to prevent boarding from small craft.
  - LCS Vulnerability Level III – All of the capabilities of LCS Vulnerability Level II, plus retain some critical mission capability as defined in Conditions for Total Ship Survivability Analyses, Test, and Evaluation for Susceptibility and Vulnerability/Recoverability.
- DOT&E agreed to defer the TSST from LCS 1 and 2 to LCS 3 and 4. This delay affords the Navy enough time to complete the needed pre-trial damage scenario analyses. The TSST is currently scheduled to be conducted on LCS 3 in December 2013 and on LCS 4 in August 2014.
- DOT&E also agreed to defer the Shock Trials from LCS 3 and 4 to LCS 5 and 6, resulting in a one-year delay. With significant seaframe and system design changes expected, LCS 5 and 6 will be most representative of the respective class for purposes of Shock Trials. LCS 5 and 6 will also be the first ships to include shock-qualified equipment.
- DOT&E reviewed drafts of the Navy's Detail Design Integrated Survivability Assessment Reports for LCS 1 and 2. The Navy is working to address DOT&E's comments and finalize these reports.
- The Navy is planning surrogate tests to address knowledge gaps related to the vulnerability of an aluminum ship structure to weapon-induced blast and fire damage. These tests will be conducted during FY13 and FY14.
- DOT&E approved the 57 mm ammunition LFT&E Management Plan, which details the test and evaluation necessary to evaluate the lethality of the 57 mm ammunition. The Navy is coordinating with the Finnish Navy to use their operational equipment to conduct an effectiveness test exercise in September 2013.

- DOT&E approved the 30 mm ammunition LFT&E Management Plan, which details the test and evaluation necessary to evaluate the lethality of the 30 mm ammunition.
- The Navy will submit the Surface-to-Surface Missile LFT&E Management Plan, which details the test and evaluation necessary to evaluate the lethality of the missile, for approval in FY13.
- Fire insulation testing was successfully conducted on a flight deck section of LCS 2 (referred to as grillage test) on the Ex-USS *Shadwell* in March 2012. The test article exceeded performance requirements for a fully intact insulated flight deck. Weapon-induced blast and fire damage will be addressed in surrogate testing planned for FY13 and FY14.

Assessment

This assessment is based on information from DOT&E's observations of selected events and operations. The program offices have issued limited developmental test results and have not been able to provide developmental test data for independent analysis. No formal at-sea operational tests were conducted.

Program

- The draft revision of the LCS TEMP currently being proposed by the Navy will require additional revisions to be approved by DOT&E. In particular, the TEMP must incorporate phased operational testing of all increments of mission module capability to be deployed for use in combat.

Seaframe

- *Freedom* Variant (LCS 1 and 3):
  - As reported in the FY11 Annual Report, the Navy discovered cracks in the hull and superstructure of LCS 1 that required interim repairs as well as design changes. The Navy made production changes to reduce cracking on LCS 3; cracking has not been observed to date.
- *Independence* Variant (LCS 2):
  - As noted in the FY11 Annual Report, the Navy completed interim repairs on LCS 2 because of aggressive galvanic corrosion in the vicinity of water jets. The Navy is installing a system to prevent corrosion on LCS 2 during the current PSA. An Impressed Current Cathodic Protection system is planned for the water jet tunnels on LCS 4.
  - The Navy continued to work through problems associated with the Twin Boom Extensible Crane on LCS 2. Limited testing to date precludes further assessment of this variant.
- Both variants:
  - Crew size can limit the mission capabilities of the ship. Core crew size provides little flexibility to support more than one operation at a time; unplanned manning losses and corrective maintenance further exacerbate the problem. The Navy is reviewing manning levels and installing 20 additional bunks in LCS 1 for flexibility during its deployment, but is not changing the final manning levels.
  - Ship operations at high speeds cause vibrations that make accurate use of the 57 mm gun very difficult. Insufficient operator training and proficiency also appear to have contributed to the poor performance of the 57 mm gun.

SUW Module

- Both variants:
  - The Navy has not finalized how the ships will be utilized with the SUW mission module. Additionally, the Navy has not completed the revised capabilities document defining the incremental approach to fielding mission modules.
  - The 30 mm guns and associated combat system exhibit reliability problems. The Navy established a Failure Review Board to identify and correct deficiencies in 30 mm gun performance.
- *Freedom* Variant: Performance deficiencies with COMBATSS-21 and TRS-3D affect tracking and engagement of contacts.

MCM Module

- Testing of the MH-60S Block 2 AMCM System revealed significant shortfalls in performance.
  - The MH-60S helicopter with the AQS-20A sonar is not operationally effective or suitable because the helicopter is underpowered and cannot safely tow the sonar under the variety of conditions necessary. The Navy cancelled the MH-60S helicopter mission to tow the AQS-20A and OASIS. The cancellation of the OASIS mission creates a gap in LCS organic mine sweeping capability that the Navy intends to address with the implementation of UISS in Increment 3 of the MCM mission module.
  - As observed during the OA and developmental testing, the AQS-20A does not meet some Navy requirements. Contact depth localization errors exceeded Navy limits in all AQS-20A operating modes. False contacts also exceeded Navy limits in two of three search modes. The Navy has implemented modified tactics intended to mitigate these deficiencies; however, those tactics limit platform-level productivity (Area Coverage Rate Sustained). Additionally, the Navy is developing a P3I program to correct these deficiencies.
  - The analysis of test data collected during Phase A of the OA of the MH-60S and ALMDS is still in progress. Preliminary evaluation of data collected during the OA suggests that the ALMDS does not meet Navy requirements for False Classification Density or reliability. DOT&E expects to issue a formal test report in 2QFY13. The Navy has implemented modified tactics intended to mitigate this deficiency; however, those tactics limit platform-level productivity (Area Coverage Rate Sustained). Additionally, the Navy is developing a P3I program to correct this deficiency. Phase B testing was originally intended to provide early operational testing insight into the operational effectiveness and suitability of AMCM systems when operating from an

LCS, and to identify risk to the successful completion of IOT&E. However, the Navy's postponement of Phase B testing will eliminate these intended benefits.
- As reported by the Navy, the reliability of RMMV version 4.1 grew as predicted by the program's reliability growth curve. However, the observed growth is predicated on limited test data collected in a minimally stressing operational environment. The limited scope of testing prevents any meaningful conclusions about operational availability of the RMS.
- As observed and reported by the Navy, during developmental testing (DT-B2), launch and recovery of the RMS was problematic due to material deficiencies with launch and recovery systems, manpower and training deficiencies, and compatibility with the operating environment.

LFT&E
- LCS is not expected to be survivable in that it is not expected to maintain mission capability after taking a significant hit in a hostile combat environment. This assessment is based on a review of LCS design requirements, which do not require the inclusion of the survivability features necessary to conduct sustained operations in its expected combat environment. DOT&E's review of the Navy's draft Detail Design Integrated Survivability Assessment Reports has not changed this assessment.

Recommendations
- Status of Previous Recommendations. The Navy has partially addressed one FY09 recommendation to develop an LFT&E program with the approval of the LFT&E Management Plan; however, the recommendation will not be fully addressed until the details of the surrogate testing and the lethality testing are developed. The Navy has partially addressed the FY10 recommendations to implement all recommendations from DOT&E's Combined Operational and Live Fire Early Fielding Report. Significant remaining recommendations from the Early Fielding Report include enhancing sensors and improving capability of gun systems. With respect to FY11 recommendations, the Navy is adjusting tactics and increasing funding to address deficiencies with the AQS-20A and ALMDS. The FY11 recommendation for the Navy to continue to report vulnerabilities during live fire tests remains valid.
- FY12 Recommendations. The Navy should:
  1. Complete the revised capabilities document defining the incremental approach to fielding mission modules.
  2. Publish the concept of operations for all the mission modules.
  3. Complete manning level studies and finalize manning prior to LCS IOT&E.
  4. Correct gun reliability issues identified during QRA. These problems need to be addressed prior to completion of the LCS SUW Mission Package IOT&E.
  5. Conduct LCS ship-based phases of the planned OA of the MH-60S Block 2 and ALMDS as well as an OA of the MH-60S Block 2 and AMNS MCM systems in FY13 to reduce risk to the LCS MCM Mission Package IOT&E.
  6. Investigate and correct material deficiencies with mission module launch and recovery systems, and manpower and training deficiencies that prevent safe and effective shipboard launch and recovery of the RMS.

LPD-17 *San Antonio* Class Amphibious Transport Dock

Executive Summary

- The Navy demonstrated the efficacy of LPD-17's collective protection system, its countermeasure wash-down system, and the crew's ability to decontaminate the ship's equipment, personnel, and spaces, and to conduct amphibious operations in chemical protective suits during FOT&E in February 2012.
- The Navy conducted FOT&E in August 2012 to examine the reliability of systems during the first five hours of an amphibious assault. Testing was not sufficient to demonstrate that the ship class satisfies its requirements.
- The Navy is working to correct deficiencies identified during IOT&E that led DOT&E to assess the ship not operationally effective, not operationally suitable, and not survivable in a hostile environment. However, correction of a number of these deficiencies has not yet been verified by follow-on operational testing.
- The Navy's Board of Inspection and Survey (INSURV) assessed the material condition of LPD-17, LPD-22, and LPD-23 as satisfactory.

System

- LPD-17 is a diesel engine-powered ship designed to embark, transport, and deploy ground troops and equipment. Ship-to-shore movement is provided by Landing Craft Air Cushion (LCAC), Landing Craft Utility (LCU), Amphibious Assault Vehicles (AAVs), MV-22 tiltrotor aircraft, and/or helicopters. Key ship features and systems include the following:
  - A floodable well deck for LCAC, LCU, and AAV operations
  - A flight deck and hangar to support Navy and Marine Corps aircraft and helicopters
  - Command, Control, Communications, Computers, and Intelligence facilities and equipment to support Marine Corps Landing Force operations
  - Self defense against anti-ship cruise missile capability provided by the Ship Self-Defense System (SSDS) Mk 2-based combat system, which includes the Cooperative Engagement Capability radar tracking system and data distribution system, the Rolling Airframe Missile point defense system, the SLQ-32B (V)2 (with Mk 53 Decoy Launching System with Nulka electronic decoys) passive electronic warfare system, and radars (SPQ-9B horizon search radar and SPS-48E long-range air search radar)

  - Two Mk 46 30 mm gun systems and smaller caliber weapons (e.g., Mk 2 .50-caliber machine guns) to provide the ship's self-defense against small surface threats
  - A Shipboard Wide Area Network that serves as the data backbone for most of the ship's computer systems (LPD-17 is one of the first ships built with a fully integrated data network system).
  - Design features that reduce the ship's radar cross section and are intended to make the ship less susceptible to attack

Mission

- A Fleet Commander will employ LPD-17 class ships as part of a notional, three-ship Amphibious Ready Group or independently to conduct Amphibious Warfare.
- The Commanding Officer will use these ships to:
  - Transport combat and support elements of a Marine Expeditionary Unit or Brigade
  - Embark, launch, and recover LCACs, LCUs, and AAVs for amphibious assault missions
  - Support aerial assaults by embarking, launching, and recovering Marine Corps aircraft
  - Carry and discharge cargo to sustain the landing force
  - Conduct non-combatant evacuation operations and other crisis response missions

Major Contractor

Huntington Ingalls Industries – Pascagoula, Mississippi

Activity

- The Navy completed FOT&E designed to demonstrate capability to conduct operations in a chemical warfare environment (onboard LPD-21) in February 2012.
- The Navy conducted limited reliability FOT&E on ship systems during the first five hours of an amphibious assault (onboard LPD-20) in August 2012.
- The Navy's INSURV assessed the material condition of LPD-17, LPD-22, and LPD-23 as satisfactory during Acceptance Trials.
- The Navy, using the Probability of Raid Annihilation Test Bed Modeling and Simulation tool, commenced a modeling and simulation study to determine if upgrades and corrections to the ship's combat system improve the ship's capability to defeat raids of anti-ship cruise missiles.
- The Navy provided its final survivability assessment identifying 99 deficiencies to DOT&E in FY12 and commenced corrective actions. However, the Navy has not submitted the shock deficiency correction plan nor demonstrated the effectiveness of corrective actions taken to date.

Assessment

- The Navy demonstrated the efficacy of LPD-17's collective protection system, its countermeasure wash-down system, and its crew's ability to decontaminate the ship's equipment, personnel, and spaces, and to conduct amphibious operations in chemical protective suits during FOT&E.
- The Navy has made progress in improving reliability and availability of critical ship systems affecting communications and propulsion based on results from INSURV and limited reliability testing onboard LPD-20. However, reliability and availability of the ship's critical systems require further improvements to assure the ship is both operationally effective and survivable.
- Since IOT&E, the Navy has not conducted any operational testing to demonstrate improvements to LPD-17's capability to defend itself against the threats it is likely to encounter to permit a reassessment of that capability. However, operational testing on other SSDS Mk 2 platforms has revealed similar combat system deficiencies to those found during LPD-17's IOT&E, confirming these issues are not LPD-17 specific. DOT&E's classified report to Congress in November 2012 titled "Ship Self-Defense Operational Mission Capability Assessment Report," provides details. The Navy is conducting a study of Probability of Raid Annihilation against anti-ship cruise missiles and expects to provide their report in the spring of 2013.
- Although improvements have been made, the Navy has not yet demonstrated the fully effective Command, Control, Communications, Computers, and Intelligence capabilities needed to support LPD-17 when performing amphibious assault operations. The Joint Staff issued the Joint Interoperability Certification (with conditions) on October 26, 2012, but the Navy still needs to successfully test the Advanced Field Artillery Tactical Data System onboard LPD-17.

Recommendations

- Status of Previous Recommendations. The Navy has satisfied recommendations relating to interoperability testing with AV-8B aircraft; completion of chemical, biological, and radiological defense testing; review of past INSURV inspections; initiation of the Probability of Raid Annihilation modeling and simulation effort; and improving the performance of the SPS-48E in the Advanced Enclosed Mast Structure. The Navy should act on the remaining 10 recommendations, which are listed below.

FY08

1. Test fixes to critical systems including the Shipboard Wide Area Network and review the effect of ship's manning, training, and logistics support on the reliability and maintainability of ship systems.

FY09

2. Address and test fixes to reliability problems with amphibious support equipment and propulsion equipment during FOT&E.
3. Continue to pursue mitigations to address integration problems with self defense in multiple warfare areas.
4. Conduct FOT&E in order to demonstrate improvements to performance problems related to the Advanced Enclosed Mast Structure (verify installation of the shroud on the SPS-48E radar corrects performance problems).

FY10

5. Improve reliability of critical systems including gun systems, Magnetic Signature Control System, and effectiveness of SSDS Mk 2-based combat system.
6. Measure Total Ship Operational Availability over an extended period after completing reliability improvements.

FY11

7. Correct remaining deficiencies from Shock Trial Reports.
8. Complete FOT&E to test Information Assurance.
9. Conduct FOT&E using the Advanced Mine Simulation System to determine vulnerability of LPD-17 to enemy mines.
10. Incorporate outstanding test events as FOT&E into the LPD-17 Test and Evaluation Master Plan.

- FY12 Recommendations. The Navy should:

1. Develop an FOT&E test plan for adequate, rigorous testing of the critical ship systems that must perform reliably to assure LPD-17 is operationally effective and survivable.
2. Complete and disseminate the Probability of Raid Annihilation study.

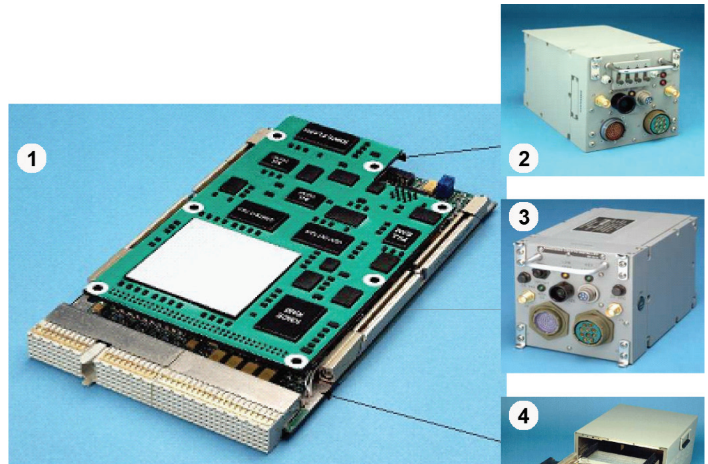
Mark XIIA Identification Friend or Foe (IFF) Mode 5

Executive Summary

- Independent Mark XIIA Mode 5 Identification Friend or Foe (IFF) (referred to as "Mode 5") programs exist in each U.S. Military Service as well as some NATO countries. Although not a joint program, the Services are developing equipment capable of employment on multiple Service platforms.
  - Of the four separate Service efforts, the Navy has the only established Acquisition Category II program, with incorporation of Service-specific Mode 5 capability through platform-specific Engineering Change Proposals (ECPs).
  - The Army and Marine Corps will leverage the Navy program and the Air Force will execute individual ECPs on their affected hardware.
- Although the Services are designing and building Mode 5 systems to comply with NATO and DoD IFF standards, DOT&E initiated oversight because of the concern that the multiple programs and vendors add risk to achieving joint interoperability.
- The Navy conducted an IOT&E of Mode 5 capability that included significant joint Service participation in FY12. However, the event was severely truncated due to adverse weather. Lack of adequate test data prevented DOT&E from fully assessing system effectiveness and suitability under realistic operational conditions. However, there were sufficient data to assess the performance of the individual components that comprise the Navy Mode 5 system. Those components met their performance thresholds and the Navy Acquisition Executive granted full-rate production authority to the program in July 2012.
- Following IOT&E, the Program Office released new software builds for both its transponder and interrogator systems to address those discrepancies highlighted during the operational test and subsequent reporting. Additional testing is required to assess the performance of these software fixes as well as the Mode 5 interoperating with both existing and planned IFF systems. The next opportunity to conduct that testing is now planned for the 3QFY13. Successful planning and execution of this event should resolve DOT&E concerns about joint interoperability and identification in a system-of-systems context.

System

- The Mark XIIA Mode 5 IFF is a cooperative identification system that uses interrogators and transponders located on host platforms to send, receive, and process friendly identification data.
- Mode 5 is a military-only identification mode, which modifies the existing Mark XII Mode 4 IFF (referred to as "Mode 4") system and addresses known shortcomings of the legacy Mode 4 identification mode. Mode 5 will eventually replace



1 - Replacement Card for Mode 5 Capability
2 - RT-1832 F/A-18 Interrogator
3 - APX-123 Navy Transponder (All Platforms)
4 - UPX-41C Shipboard Interrogator

Mode 4 and allows National Security Agency-certified secure encryption of interrogations and replies. Primary system features include:
  - A lethal interrogation format, which is used by a "shooter" prior to weapons release as a final attempt to get a valid Mode 5 reply from the target, even with the target's interrogated Mode 5 transponder system in standby; this is intended to reduce fratricide
  - A random-reply-delay, which prevents overlapping replies and provides better display discrimination for closely spaced platforms
- Mode 5 offers more modern signal processing, compatibility with legacy Mode 4 systems and civilian air traffic control, and secure and encrypted data exchange through the use of the new waveform.
- Mode 5 serves as a component of the combat identification process used on ground-based systems such as the Army's Patriot missile system, sea-based systems such as Aegis-equipped ships, and military aircraft to include the E-3 Airborne Warning and Control System and E-2 Hawkeye command and control platforms.
- Independent Mode 5 programs exist in each U.S. Military Service as well as some NATO countries. Although not a joint program, the Services are developing equipment capable of employment on multiple Service platforms.
  - Of the four separate Service efforts, the Navy has the only established Acquisition Category II program, with incorporation of Service-specific Mode 5 capability through platform-specific ECPs.

- The Army and Marine Corps will leverage the Navy program, and the Air Force will execute individual ECPs on its affected hardware.

Mission

The Combatant Commander employs the Mode 5 system to provide positive, secure, line-of-sight identification of friendly platforms equipped with an IFF transponder. In the future, this system's information will be combined with other cooperative and non-cooperative combat identification techniques in order to provide identification of all platforms – enemy, neutral, and friendly.

Major Contractor

BAE Systems – Arlington, Virginia

Activity

- Although the Services are designing and building Mode 5 systems to comply with NATO and DoD IFF standards, DOT&E initiated oversight because of the concern that the multiple programs and vendors add risk to achieving joint interoperability.
- The Navy executed IOT&E on their Mode 5 system for shipboard interrogators and transponders as well as aircraft transponders from October through November 2011. The Navy executed the test in accordance with the DOT&E-approved Test and Evaluation Master Plan (TEMP) and test plan; however, poor weather and technical test execution deficiencies truncated the amount of test data recorded. There were sufficient data to assess the performance of the Navy Mode 5 system-under-test; however there was insufficient data to provide a full assessment of the Mode 5 system-of-systems interoperability and suitability.
- DOT&E published its IOT&E report in July 2012, assessing the Navy's Mode 5 hardware/software as well as the overarching Mode 5 system-of-systems. The Navy Acquisition Executive approved full-rate production of the Navy Mode 5 system in July 2012 following the Navy Mode 5 IOT&E.
- The Army and Air Force are developing and testing Service-specific Mode 5 capabilities:
  - The Army developed a Mode 5 Air Defense Interrogator for the Patriot and Sentinel systems; it is currently in developmental testing.
  - The Air Force is developing a separate Mode 5 interrogator for the E-3 Airborne Warning and Control System.
  - The Air Force Operational Test and Evaluation Center tested the integration of an Air Force-developed Mode 5 interrogator and transponder on the F-15C/E aircraft in conjunction with the Navy IOT&E in November 2011.
- The Navy submitted, and DOT&E approved, a revised Test and Evaluation Master Plan that will ensure that Mode 5 is assessed in operationally realistic environments that include (in addition to Navy ship and aircraft platforms) a variety of Army, Air Force, and allied systems equipped with Mode 5 capability.
- USD(AT&L) and DOT&E worked with the Services to develop and approve a revised Joint Operational Test Approach (JOTA) (version 2.0) document to guide Mode 5 interoperability testing across the DoD.
  - Utilizing the approved JOTA guidance, the Navy is currently leading development of a test concept for the conduct of an operationally realistic test of Mode 5 capability in 2013.
  - This event will employ a variety of joint Service and allied aircraft equipped with interrogators and transponders using representative flight profiles. JOTA efforts are critical to informing the DoD-wide FY14 Mode 5 Initial Operational Capability and FY20 Full Operational Capability declarations.

Assessment

- During IOT&E, Mode 5 demonstrated significant improvement over the existing Mode 4. However, weather limited the scope of testing and prevented a complete operational assessment. Lack of adequate test data prevented DOT&E from fully assessing system effectiveness and suitability under operationally realistic conditions. However, there were sufficient data to assess the performance of the individual hardware components that comprise the Navy Mode 5 system. Those components met their individual performance requirements thresholds during the IOT&E.
- Although no hardware or software failures occurred during IOT&E, DOT&E observed substantial suitability deficiencies, including short battery life, easily triggered anti-tamper features, and difficulty loading cryptographic keys.
- The IOT&E highlighted interoperability concerns between Mode 5 and other systems onboard Navy ships. These include:
  - Shipboard integration problems of Navy Mode 5 equipment into the larger shipboard Aegis weapons system, which could cause incorrect engagement decisions with potentially severe consequences.
  - Problems with the accurate and timely flow of Mode 5-derived identification information between components of the Navy Cooperative Engagement Capability system.
- Following IOT&E, the Program Office released new software builds for both its transponder and interrogator systems to address those discrepancies highlighted during the operational test and subsequent reporting. Additional testing is required to assess the performance of these software fixes as well as the Mode 5 interoperating with both existing and planned IFF

systems. The next opportunity to conduct that testing is now planned for the 3QFY13. Successful planning and execution of this event should resolve DOT&E concerns about joint interoperability and identification in a system-of-systems context.

Recommendations

- Status of Previous Recommendations. The Navy has adequately addressed all previous recommendations.
- FY12 Recommendations.
  1. In order to ensure interoperability between interrogators, transponders, and combined interrogator-transponders, the Service program managers must continue to integrate their test schedules. Additionally, all Services must fully participate in the JOTA evaluation process to ensure that Mode 5 capabilities are tested in a realistic joint Service environment.
  2. The Navy needs to address problems with the Mode 5 shipboard integration on the Aegis weapons system and the information flow between Mode 5 and the Cooperative Engagement Capability command and control infrastructure to ensure that the Mode 5 system capabilities are fully effective.

MH-60R Multi-Mission Helicopter

Executive Summary
- DOT&E issued a combined FOT&E report (MH-60R and MH-60S) in April 2012 assessing the operational effectiveness and operational suitability of selected systems of the MH-60R Pre-Planned Product Improvement Program. The Ground Proximity Warning System (GPWS) and the Integrated Maintenance Diagnostic System (IMDS) are operationally effective and operationally suitable for all MH-60R missions. The overall assessment of the MH-60R airframe for all mission areas remains operationally effective, operationally suitable, and survivable.
- The Navy's Commander, Operational Test and Evaluation Force (COTF) commenced two tests in 4QFY12. Both tests are anticipated to complete in 1QFY13:
  - IOT&E of MH-60R equipped with the Automatic Radar Periscope Detection and Discrimination (ARPDD) Upgrade
  - Testing focused on previously identified Multi-spectral Targeting System (MTS) deficiencies
- The analyses of test data collected during IOT&E of MH-60R with ARPDD and testing of MH-60R with MTS are still in progress. DOT&E expects to issue formal test reports in 2QFY13.

System
- The MH-60R is a ship-based helicopter designed to operate from cruisers, destroyers, frigates, littoral combat ships, and aircraft carriers.
- It incorporates dipping sonar and sonobuoy acoustic sensors, multi-mode radar, electronic warfare sensors, a forward-looking infrared sensor with laser designator, and an advanced mission data processing system.
- It employs torpedoes, Hellfire air-to-surface missiles, and crew-served mounted machine guns.
- It has a three-man crew: two pilots and one sensor operator.

Mission
The Maritime Component Commander employs the MH-60R from ships or shore stations to accomplish the following:
- SUW, Under Sea Warfare, Area Surveillance, Combat Identification, and Naval Surface Fire Support missions previously provided by two different helicopters (SH-60B and SH-60F)
- Support missions such as Search and Rescue at-sea and, when outfitted with necessary armament, maritime force protection duties

Major Contractors
- Sikorsky Aircraft Corporation – Stratford, Connecticut
- Lockheed Martin Mission System and Sensors – Owego, New York

Activity
- DOT&E issued a combined FOT&E report (MH-60R and MH-60S) in April 2012 assessing the operational effectiveness and operational suitability of selected systems of the MH-60R Pre-Planned Product Improvement Program. The tested systems were the GPWS and the IMDS. COTF completed testing in 1QFY12. COTF conducted the testing in accordance with the DOT&E-approved test plan.
- COTF commenced IOT&E of MH-60R with the ARPDD Upgrade in 4QFY12. COTF conducted the testing in accordance with a DOT&E-approved test plan. Testing is anticipated to complete in 1QFY13.
- COTF commenced testing of previously identified deficiencies of the MH-60R with MTS in 4QFY12. Testing was conducted in accordance with a DOT&E-approved data management and analysis plan and is anticipated to complete in 1QFY13.
- All LFT&E activities have been completed and reported in the LFT&E report to Congress in 2008.

Assessment
- The GPWS and IMDS are assessed to be operationally effective and operationally suitable for all MH-60R missions. There were no significant operational effectiveness or operational suitability deficiencies identified during testing. The test results did not affect any prior findings on the overall operational effectiveness, operational suitability, or survivability of the MH-60R airframe in any mission area.

- The analysis of test data collected during IOT&E of MH-60R with ARPDD is still in progress. DOT&E expects to issue a formal test report in 2QFY13.
- The analysis of test data collected during testing of MH-60R with MTS is still in progress. The scope of the testing was focused on previously identified MTS deficiencies. The testing was not designed to assess surface warfare mission capability of MH-60R when equipped with MTS and the Hellfire missile. DOT&E expects to issue a formal test report in 2QFY13.

Recommendations

- Status of Previous Recommendations. The Navy satisfactorily addressed the four previous recommendations.
- FY12 Recommendation.
  1. The Navy should plan to conduct FOT&E to assess MH-60R's surface warfare capability when equipped with MTS and the Hellfire missile.

MH-60S Multi-Mission Combat Support Helicopter

Executive Summary

- The Navy's Commander, Operational Test and Evaluation Force (COTF) completed testing of selected systems of the MH-60S Pre-Planned Product Improvement (P3I) Program in 1QFY12. DOT&E issued a combined FOT&E report (MH-60R and MH-60S) in April 2012 assessing the operational effectiveness and operational suitability of these systems. The Active Vibration Control System (AVCS), Ground Proximity Warning System (GPWS), and Integrated Maintenance Diagnostic System (IMDS) are operationally effective and operationally suitable for all MH-60S missions. The overall assessment of the MH-60S airframe remains operationally effective, operationally suitable, and survivable for all mission areas.
- COTF completed testing of the MH-60S Block 2 Airborne Mine Countermeasures (AMCM) System in 4QFY11. DOT&E issued an operational assessment (OA) report in June 2012 assessing operational effectiveness and operational suitability of the minehunting capability meant to be provided by the AMCM System and the AN/AQS-20A Sonar Mine Detecting Set (AQS-20A).
  - The MH-60S helicopter with the AQS-20A sonar is not operationally effective or suitable because the helicopter is underpowered and cannot safely tow the sonar under the wide variety of conditions necessary.
  - As observed during the OA and developmental testing, the AQS-20A does not meet some Navy requirements.
- COTF completed two test events in 4QFY12. The analysis of test data collected during these events is still in progress.
  - Phase A (Shore-based and Training Phase) of the planned OA of the MH-60S Block 2 AMCM System and the Airborne Laser Mine Detection System (ALMDS), commenced in 2QFY12. Preliminary evaluation of data collected during the OA suggests that the ALMDS does not meet Navy requirements for False Classification Density (FCD) and has low reliability. DOT&E expects to issue a formal test report in 1QFY13.
  - The Quick Reaction Assessment (QRA) of MH-60S with the 20 mm Gun System (Forward Fixed Firing Weapon) commenced in 3QFY12. Preliminary evaluation of data collected during the QRA suggests that the 20 mm Gun System may provide enhanced Surface Warfare performance to the MH-60S helicopter. DOT&E expects to issue a formal test report in 1QFY13.
- COTF commenced testing focused on previously identified Multi-spectral Targeting System (MTS) deficiencies in 4QFY12; testing is anticipated to complete in late 1QFY13. The analysis of test data collected during testing of MH-60S with MTS is still in progress. DOT&E expects to issue a formal test report in 2QFY13.

System

- The MH-60S is a helicopter modified into three variants (Blocks) from the Army UH-60L Blackhawk. It is optimized for operation in the shipboard/maritime environment.
- The Blocks share common cockpit avionics and flight instrumentation with the MH-60R.
- Installed systems differ by Block based on mission:
  - Block 1, Fleet Logistics – precision navigation and communications, maximum cargo or passenger capacity
  - Block 2A/B, AMCM System – AMCM system operator workstation, a tether/towing system, and the two MCM systems currently under development; ALMDS for detection and classification of near-surface mines and the Airborne Mine Neutralization System (AMNS) for neutralization of in-volume and bottom mines. The AQS-20A sonar system and Organic Airborne and Surface Influence Sweep are no longer being developed for use in the AMCM System
  - Block 3A, Armed Helicopter – tactical moving map display, forward-looking infrared with laser designator, crew-served side machine guns, dual-sided Hellfire air-to-surface missiles, and defensive electronic countermeasures
  - Block 3B, Armed Helicopter – Block 3A with addition of tactical datalink (Link 16)
- P3I components add Link 16 and various communication, navigation, and command and control upgrades.

Mission

The Maritime Component Commander can employ variants of MH-60S from ships or shore stations to accomplish the following missions:

- Block 1 – Vertical replenishment, internal cargo and personnel transport, medical evacuation, Search and Rescue, and Aircraft Carrier Plane Guard
- Block 2 – Detection, classification, identification and/or neutralization of sea mines depending on which AMCM systems are employed on the aircraft
- Block 3 – Combat Search and Rescue, Surface Warfare, Aircraft Carrier Plane Guard, Maritime Interdiction Operations, and Special Warfare Support

Major Contractors

- Sikorsky Aircraft Corporation – Stratford, Connecticut
- Lockheed Martin Mission System and Sensors – Owego, New York
- Raytheon Company, Integrated Defense Systems – Tewksbury, Massachusetts
- Northrop Grumman Corporation – Melbourne, Florida

Activity

- COTF completed testing of the AVCS, GPWS, and IMDS improvements in 1QFY12. DOT&E issued a combined FOT&E report (MH-60R and MH-60S) in April 2012 assessing the operational effectiveness and operational suitability of these systems.
- COTF completed testing of the MH-60S Block 2A AMCM System and the AQS-20A in 4QFY11. DOT&E issued an OA report in June 2012 assessing operational effectiveness and operational suitability of the minehunting capability.
- COTF commenced Phase A (Shore-based and Training Phase) of the planned OA of the MH-60S Block 2 AMCM System and the ALMDS in 2QFY12; testing completed in 4QFY12. The Navy postponed conduct of Phase B (Littoral Combat Ship (LCS) Ship-based Phase) of the planned OA due to the unavailability of an LCS seaframe to facilitate conduct of MCM mission module testing. The Navy intends to conduct the LCS ship-based phase of the planned ALMDS and AMNS OAs in conjunction with the LCS Technical Evaluation scheduled to occur in FY14.
- COTF conducted all testing in accordance with the DOT&E-approved test plan.
- COTF commenced a QRA of MH-60S with the 20 mm Gun System (Forward Fixed Firing Weapon) in 3QFY12; testing completed in 4QFY12. COTF conducted the assessment in accordance with the DOT&E-approved data management and analysis plan.
- COTF commenced testing of previously identified deficiencies of the MH-60S with MTS in 4QFY12. COTF conducted the testing in accordance with a DOT&E-approved data management and analysis plan. Testing is anticipated to complete in 1QFY13.
- All LFT&E activities have been completed and reported in the LFT&E report to Congress in 2008.

Assessment

- The AVCS, GPWS, and IMDS are assessed to be operationally effective and operationally suitable for all MH-60S missions. There were no significant operational effectiveness deficiencies identified during testing. The test results did not affect any prior findings on the overall operational effectiveness, operational suitability, or survivability of the MH-60S airframe in any mission area.
- The MH-60S helicopter and AQS-20A sonar are not operationally effective or suitable because the helicopter is underpowered and cannot safely tow the sonar under the variety of conditions necessary. The Chief of Naval Operations recently concluded that the MH-60S helicopter is significantly underpowered for the safe performance of the AMCM tow mission and provides limited tactical utility relative to the risk to aircrew, and cancelled that MH-60S mission. The decision to cancel the AMCM tow mission affects employment of both the AQS-20A sonar and Organic Airborne and Surface Influence Sweep.
- As observed during the OA and developmental testing, the AQS-20A does not meet all Navy requirements in all operating modes. Contact depth (vertical localization) errors exceeded Navy limits in all AQS-20A operating modes. FCD also exceeded Navy limits in two of three search modes.
- The analysis of test data collected during Phase A of the OA of the MH-60S and ALMDS is still in progress. Preliminary evaluation of data collected during the OA suggests that the ALMDS does not meet Navy requirements for FCD or reliability. DOT&E expects to issue a formal test report in 2QFY13. Phase B testing was originally intended to provide early operational testing insight into the operational effectiveness and suitability of AMCM systems when operating from an LCS, and to identify risk to the successful completion of IOT&E. However, the Navy's cancellation of Phase B testing will eliminate these intended benefits.
- The analysis of test data collected during the QRA of MH-60S with the 20 mm Gun System (Forward Fixed Firing Weapon) is still in progress. Preliminary evaluation of data collected during the QRA suggests that the 20 mm Gun System may provide enhanced Surface Warfare performance to the MH-60S helicopter. DOT&E expects to issue a formal test report in 1QFY13.
- The analysis of test data collected during testing of MH-60S with MTS is still in progress. The scope of the testing was focused on previously identified MTS deficiencies. The testing was not designed to assess Surface Warfare mission capability of MH-60S when equipped with MTS and the Hellfire missile. DOT&E expects to issue a formal test report in 2QFY13.

Recommendations

- Status of Previous Recommendations. The Navy satisfactorily addressed 8 of the 11 previous recommendations. The Navy should still:
  1. Investigate solutions and correct AN/AQS-20A FCD and Vertical Localization deficiencies prior to IOT&E.
  2. Investigate solutions and correct the ALMDS FCD deficiency prior to IOT&E.
  3. Conduct LCS ship-based phases of the planned OA of the MH-60S Block 2 and ALMDS as well as an OA of the MH-60S Block 2 and AMNS MCM systems in FY13 to reduce risk to the LCS MCM Mission Package IOT&E.
- FY12 Recommendation.
  1. The Navy should plan to conduct FOT&E to assess MH-60S's surface warfare capability when equipped with MTS and the Hellfire missile.

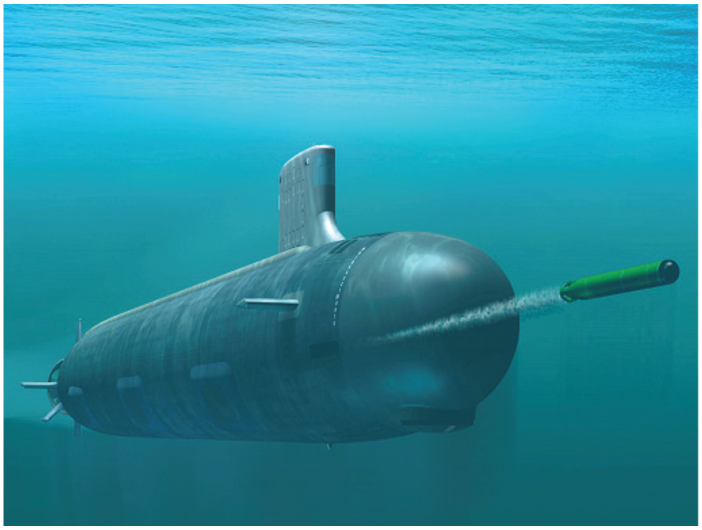
Mk 48 Advanced Capability (ADCAP) Torpedo Modifications

Executive Summary

- In FY12, the Navy continued operational testing of the Advanced Processor Build (APB) Spiral 4 operational software for the Mk 48 Advanced Capability (ADCAP) Modification (Mod) 7 Common Broadband Advanced Sonar System (CBASS) torpedo and Mk 48 ADCAP Mod 6 Advanced Common Torpedo (ACOT). OT&E, which began in FY11, is expected to continue into early FY13.
- Since the commencement of operational testing in FY11, the Navy has fired approximately 330 torpedoes equipped with Spiral 4 tactical software for training and testing at both surface and submerged targets in a variety of different environmental and tactical scenarios. These scenarios have included targets deploying multiple static countermeasures, targets deploying the mobile countermeasure, and targets designed to emulate the threat identified in the Navy's Urgent Operational Needs Statement (UONS) of March 19, 2010.
- Because the Navy did not complete developmental testing before early fielding and before commencing operational testing of the Mk 48 Spiral 4 torpedo, operational testers, the Navy's laboratories, and fleet users identified several performance deficiencies during operational testing. The Navy interrupted the operational testing and issued new Mk 48 Spiral 4 torpedo operational software with the intention of fixing identified deficiencies.

System

- The Mk 48 ADCAP torpedo is the only Anti-Submarine Warfare and Anti-Surface Ship Warfare weapon used by U.S. submarines. Mk 48 ADCAP torpedo modifications are a series of hardware and software upgrades to the weapon.
- Mk 48 Mod 6, Mod 6 Spiral 1, Mod 6 ACOT – Guidance and Control Box, and Mod 7 CBASS Phase I are fielded torpedoes.
- Mk 48 Mod 7 CBASS upgrades the Mk 48 ACOT with a new sonar designed to improve torpedo effectiveness through future software upgrades. Phase 1 torpedoes deliver the initial hardware and software; Phase 2 torpedoes are required to deliver full capability.



- The software developed for CBASS Phase 2 is designated APB Spiral 4. The Navy subsequently determined that Spiral 4 software can run on ACOT weapons as well. As a result, the Navy is testing Spiral 4 on both CBASS and ACOT weapons. The Navy has authorized the limited fielding of Mk 48 Spiral 4 torpedoes.
- CBASS is a co-development program with the Royal Australian Navy.

Mission

The Submarine Force employs the Mk 48 ADCAP torpedo as a long-range, heavy-weight weapon:

- For destroying surface ships or submarines
- In both deep-water open ocean and shallow-water littoral environments

Major Contractor

Lockheed Martin Sippican Inc. – Marion, Massachusetts

Activity

- In FY12, the Navy continued operational testing of the APB Spiral 4 operational software for the Mk 48 ADCAP Mod 7 (CBASS) torpedo and Mk 48 ADCAP Mod 6 (ACOT). OT&E, which began in FY11, is expected to continue into early FY13.
- Since the commencement of operational testing in FY11, the Navy has fired approximately 330 torpedoes equipped with Spiral 4 tactical software for training and testing at both surface and submerged targets in a variety of different environmental and tactical scenarios. These scenarios have included targets deploying multiple static countermeasures, targets deploying the mobile countermeasure, and targets designed to emulate the threat identified in the Navy's UONS of March 19, 2010.

- Relevant prior activity includes:
  - The Navy's Commander, Operational Test and Evaluation Force (COTF) observed and analyzed the results of the in-water Mk 48 Spiral 4 exercises and developmental testing from January to February 2011. COTF also conducted modeling and simulation assessments using the Weapons Analysis Facility (WAF) located at the Naval Undersea Warfare Center, Newport, Rhode Island, to examine Mk 48 Spiral 4 performance in baseline warfare scenarios.
  - The Navy released the Mk 48 Spiral 4 torpedo for limited operational use in March 2011.
  - DOT&E delivered an Early Fielding report to Congressional defense committees in March 2011.
  - The Navy has shifted to a Technical Insertion (TI) and APB model for torpedo development. The Navy intends the hardware modernizations (TIs) to address component obsolescence and to enable future capability. The Navy intends the new operational software (APBs) to use the new TI hardware and to improve the torpedo's capability.
- The Navy updated the Joint Test and Evaluation Master Plan to cover the Spiral 4 with Mk 48 ADCAP CBASS and Mk 48 ADCAP ACOT, and to address the UONS threat. DOT&E approved the updated Test and Evaluation Master Plan on January 13, 2012.
- The Navy completed development of a Submarine-Launched Countermeasure Emulator (SLACE) to support Mk 48 Spiral 4 testing. The SLACE emulator enables the Navy to conduct more realistic torpedo operational testing against threat submarine surrogates that can employ mobile countermeasures. The Navy also developed a Steel Diesel Electric Submarine surrogate to evaluate torpedo performance against submarine threats in limited operational scenarios.
- DOT&E approved the OT&E initial test plan for Mk 48 Spiral 4 on July 14, 2011, to support the initial operational test events. Because the Navy was unable to identify future test locations and test resources, and provide the execution details of the operational scenarios, DOT&E required the Navy to update the test plan once the follow-on testing was planned and before conducting the remainder of the operational testing. DOT&E approved updated test plans on June 15, 2012, and August 24, 2012. DOT&E also required the Navy to submit a final update to the test plan once the details of the remainder of the Mk 48 Spiral 4 testing were known.
- The Navy conducted the first phase of Spiral 4 operational testing in conjunction with FOT&E on the *Virginia* class submarine in March 2011 off Maui and at the Pacific Missile Range Facility off Kauai, Hawaii. Submarines fired 17 Spiral 4 weapons with software versions 3x.4.3 and 3x.4.4.
- In June 2011, the Navy conducted 10 firings, with Spiral 4 software version 3x.4.4, off southern California.
- In September 2011, the Navy conducted 10 additional Mk 48 Spiral 4 torpedo developmental test events using the Steel Diesel Electric Submarine target surrogate at a shallow-water site off the Virginia coast. The purpose was to gain additional torpedo performance information against the UONS threat.
- In December 2011, the Navy issued Mk 48 Spiral 4 torpedo software version 3x.4.6 to correct problems identified in the completed testing and by fleet operators. In order to avoid the costly repetition of all completed operational testing, the Navy's testers evaluated the effects of these changes on the torpedo's performance. Test events where performance would likely be affected by the new software change were invalidated from the operational test database and retesting was incorporated into future test periods.
- The Navy conducted 13 firings with the new Spiral 4 software, version 3x.4.6, in June 2012 in the Narragansett Bay Operating Area. This test was held in conjunction with a Tactical Development Exercise that featured another 12 torpedo firings.
- In September 2012, the Navy conducted 11 Spiral 4 shots with software version 3x.4.6 at two sites off Maui, Hawaii. An Australian *Collins* class diesel submarine served as the target and four of the runs featured the SLACE mobile countermeasure emulator.
- During FY12, the Navy employed Spiral 4 weapons during four Submarine Command Course exercises at the Atlantic Undersea Test and Evaluation Center and the Pacific Missile Range Facility. To conserve test resources, DOT&E agreed to utilize these torpedo events as regression testing to evaluate the performance of the Mk 48 Spiral 4 in some deep-water scenarios.
- In October 2012, the Navy conducted an additional three Spiral 4 shots with software version 3x.4.6 off Cape Cod, Massachusetts.
- The Navy accredited the WAF, located at the Navy Undersea Warfare Center, in August 2012 to compare the performance of the two hardware versions of the Mk 48 torpedo that use the Spiral 4 software.
- The Navy conducted two Mk 48 Sink Exercise (SINKEX) events in FY12, using war-shot torpedoes. Both SINKEXs were executed by allied submarine forces. A Canadian submarine fired an Mk 48 Mod 4M (Mk 48 version sold to allies), while an Australian submarine fired a Mk 48 Mod 7. These test events confirmed the warhead performance of in-service and stored Mk 48 torpedoes.

Assessment

- The Navy's Quick Reaction Assessment and WAF testing of the Mk 48 Spiral 4 torpedo enabled a limited assessment of its performance. DOT&E's report on the early fielding assessed that testing indicated the Mk 48 Spiral 4 has a limited capability, under certain operational conditions, against the threat identified in the UONS; however, the Navy did not have adequate threat surrogates for the evaluation. DOT&E's assessment also reported that the Spiral 4 torpedo did not demonstrate expected improvements over the legacy torpedo, and may degrade current capability in certain warfare scenarios.
- Additional information on Mk 48 Spiral 4 performance can be found in DOT&E's classified Mk 48 ACOT and CBASS Spiral 4 Early Fielding Report dated March 18, 2011.

- During operational testing, the Navy's testers and laboratories discovered several torpedo deficiencies not identified during developmental testing that resulted in the Navy developing software corrections intended to fix the identified deficiencies. The Navy used the WAF for assessing the software changes, issued a new software version, and continued with the operational testing. As the WAF consistently overestimates performance and was not accredited for evaluating torpedo effectiveness or for operational testing of the Mk 48 Spiral 4, DOT&E assesses this development approach as high risk for adequately predicting satisfactory torpedo in-water performance.
- The Navy and DOT&E are assessing the completed Mk 48 Spiral 4 test events for operational realism and validity incrementally as the fleet training and test events are completed. Most fleet training events have been too structured or lacked the necessary post firing operational conditions to meet required torpedo test conditions. Navy testers are working with fleet trainers to improve the post torpedo firing operational realism.
- Due to delays in completing the development of the SLACE mobile countermeasure surrogate and the Navy's focus on the UONS threat, the Navy did not conduct adequate developmental testing against SLACE-like countermeasures. DOT&E assessed that Mk 48 Spiral 4 performance against SLACE-like threats is high risk because the Program Office completed little in-water developmental testing. Assessment of the Mk 48 Spiral 4 operational testing with SLACE, conducted in September 2012, is in progress.
- Due to the shortage of available test submarine shooters and targets, the Navy continues to have difficulty scheduling and planning adequate torpedo operational test events. Thus, Navy testers have been unable to provide the execution details for completing operationally realistic events for all required Mk 48 Spiral 4 test events. As a result, DOT&E has required the Navy to submit updates to the test plan once the event details are known and approved the testing event by event.
- Initial regression and operational testing results indicate Mk 48 performance in deep-water and shallow-water areas has not substantially changed; however, insufficient testing has been completed to allow a statistically significant assessment.

Recommendations

- Status of Previous Recommendations. The Navy has addressed six of the nine previous Annual Report recommendations. The three outstanding recommendations are as follows:
  1. While some improvements have been made by conducting regression testing in conjunction with scheduled fleet training events and by using WAF simulations, the Navy should continue to address reducing in-water test delays and improve the WAF simulations.
  2. As the Navy continues to conduct only limited torpedo training and testing in shallow waters, they should develop shallow-water test and training areas and modernize the exercise torpedo locating and recovery systems.
  3. The Navy should complete development of threat representative target and countermeasure surrogates for torpedo testing. In addition to representing the physical and signature characteristics of the threat, the surrogate should be capable of emulating appropriate operational profiles of the threat.
- FY12 Recommendations. The Navy should:
  1. Plan and conduct adequate developmental testing before starting operational testing.
  2. Continue conducting the Mk 48 Spiral 4 torpedo testing in FY13. Testing should include the evaluation of torpedo performance against submarine surrogates for the small diesel-electric threat.

Mk 54 Lightweight Torpedo

Executive Summary

- In August to September 2011, the Navy fired 22 Mk 54 Block Upgrade (BUG) torpedoes against a Steel Diesel Electric Submarine surrogate target and against U.S. attack submarine targets in order to address the March 2010 Navy Fifth Fleet Urgent Operational Need Statement (UONS). Based on the results of this test, the Navy revised the Mk 54 BUG tactical software, conducted an additional phase of in-water developmental testing in November 2011, and completed a limited release of the weapon to the fleet.
- DOT&E issued an Early Fielding report on January 12, 2012. DOT&E reported that based on completed testing, crews employing the Mk 54 have a limited capability against the UONS threat under favorable targeting and environmental conditions. DOT&E also reported that the Navy's testing was completed under best-case scenarios, and the Navy did not have an adequate threat surrogate for the UONS threat. For additional details, see DOT&E's classified report.
- The Navy did not complete adequate in-water or modeling and simulation developmental testing of the Mk 54 BUG as planned. As the Program Office shifted resources to demonstrate that the Mk 54 BUG has a capability against the UONS emerging submarine threat, testing focused on the UONS threat scenarios vice the operational scenarios for which the Mk 54 BUG was originally intended.
- The Navy began operational testing on the Mk 54 with BUG software in March 2012.

System

- The Mk 54 Lightweight Torpedo is the primary Anti-Submarine Warfare weapon used by U.S. surface ships, fixed-wing aircraft, and helicopters.
- The Mk 54 combines the advanced sonar transceiver of the Mk 50 torpedo with the legacy warhead and propulsion system of the older Mk 46. The Mk 46 and Mk 50 torpedoes can be converted to an Mk 54 via an upgrade kit.
- The Mk 54 sonar processing is an expandable, open-architecture system. It combines algorithms from the Mk 50 and Mk 48 torpedo programs with the latest commercial off-the-shelf technology.
- The Navy designed the Mk 54 sonar processing to operate in shallow-water environments and in the presence of sonar countermeasures.

- The Navy has designated the Mk 54 torpedo to replace the Mk 46 torpedo as the payload section for the Vertical Launched Anti-Submarine Rocket for rapid employment by surface ships.
- The High-Altitude Anti-Submarine Warfare Weapons Capability program will provide an adapter kit to permit long-range, high-altitude, GPS-guided deployment of the Mk 54 by a P-8A Maritime Patrol Aircraft.
- The Mk 54 BUG is a software upgrade to the Mk 54 baseline torpedo designed to correct deficiencies identified during the 2004 Mk 54 IOT&E.
- The Navy is planning a series of near-term improvements to the Mk 54, including an improved sonar array and block upgrades to the tactical software.

Mission

Navy surface ships and aircraft employ the Mk 54 torpedo as their primary anti-submarine weapon:

- For offensive purposes, when deployed by Anti-Submarine Warfare aircraft and helicopters
- For defensive purposes, when deployed by surface ships
- In both deep-water open ocean and shallow-water littoral environments
- Against fast, deep-diving nuclear submarines; and slow moving, quiet, diesel-electric submarines

Major Contractor

Raytheon Integrated Defense Systems – Tewksbury, Massachusetts

Activity

- The Navy started operational testing of the Mk 54 BUG torpedo in FY12. The operational testing is being conducted with the same version of the torpedo's tactical software that the Navy early fielded in January 2012 to address the Fifth Fleet UONS threat. Relevant prior activity includes:

  - The Navy developed a Steel Diesel Electric Submarine surrogate to evaluate torpedo performance against stationary submarine threats in limited operational scenarios. The Navy also developed a Submarine-Launched Countermeasure Emulator to support torpedo testing. The emulator enables the Navy to conduct realistic torpedo operational testing against threat submarine surrogates that can employ mobile countermeasures.
  - In August to September 2011, the fleet fired 22 Mk 54 BUG torpedoes with software version 42.B.1 against a Steel Diesel Electric Submarine surrogate target and against U.S. attack submarine targets. Based on the results of this test, the Navy issued Mk 54 BUG software version 42.B.2 to correct some identified performance problems, conducted an additional phase of in-water testing in November 2011, and fielded the Mk 54 early for limited use in January 2012.
- DOT&E issued a classified Early Fielding report on January 12, 2012. DOT&E reported that based on completed testing, crews employing the Mk 54 have a limited capability against the UONS threat under favorable targeting and environmental conditions. DOT&E also reported that the Navy's testing was completed under best-case scenarios, and the Navy did not have an adequate threat surrogate for the UONS threat. For additional details, see DOT&E's classified report.
- During FY11 and FY12, the Navy updated the Mk 54 BUG Test and Evaluation Master Plan (TEMP) to address both the new testing required for the UONS threat and the planned correction of major deficiencies identified during the 2004 IOT&E. DOT&E approved the Mk 54 BUG TEMP in December 2012.
- DOT&E approved the Navy's Operational Test Plan on February 24, 2012, to cover the first phase of operational testing. Because Navy testers could not identify the test execution details of all planned future test events, DOT&E approved the test plan for the first event and required it to be updated when the execution details could be defined for the future test events. DOT&E approved an update to the test events on July 31, 2012, and expects a final test plan update to cover the remainder of the operational testing in early FY13. The Navy conducted the first phase of BUG operational testing, designated OT-B1A, off the coast of southern California in March 2012. Three weapons were fired by an *Arleigh Burke* class destroyer and five were dropped by MH-60R helicopters. Another five weapons were intended to be dropped by P-3C aircraft, but those events were cancelled due to aircraft material problems. After the testing, the Navy declared the MH-60R runs invalid due to testing irregularities.
- The Navy conducted the second phase of BUG operational testing off Cape Cod, Massachusetts, in August 2012. The P-8A aircraft delivered eight weapons; MH-60R helicopters dropped another six weapons. Three more planned torpedo runs were not completed.
- The Navy conducted the third scheduled phase of BUG operational testing off Maui, Hawaii, in September 2012. P-8A aircraft delivered eight weapons and SH-60B helicopters dropped four weapons. An additional two runs were not completed.
- The Navy is planning an additional test event to complete the remaining Mk 54 BUG testing in 3QFY13.
- As a result of concerns about warhead performance and changes to the warhead exploder, DOT&E placed the Mk 54 on live fire oversight in 2010. The Navy had completed the Mk 54 BUG exploder modification and testing; therefore, DOT&E agreed to the Navy's proposal to develop a LFT&E plan starting with the Mk 54 Mod 1 version of the torpedo. The Mk 54 Program Office met with DOT&E in July 2012, and held an LFT&E meeting in August 2012 to develop an adequate lethality program for the Mk 54 Mod 1 torpedo. DOT&E is working with the Navy to establish a strategy for LFT&E to support the FY13 Mk 54 Milestone B.
- The Navy plans to continue the Mk 54 program with the Mk 54 Mod 1 torpedo and plans to approve a new set of requirements documents in FY13.
- In September 2012, the Navy conducted the first Mk 54 Service Weapons Test in an attempt to assess the performance of the warhead. The result of the event is under evaluation.

Assessment

- The Navy originally planned the Mk 54 BUG software to improve Mk 54 classifier and tracker performance and to resolve IOT&E Mk 54 deficiencies. The UONS emerging threat provided the incentive for the Navy to accelerate the development and fielding of the Mk 54 BUG software.
- The operational profile of the UONS emerging threat and the resulting changes to the torpedo's final homing software and exploder requires further testing to confirm Mk 54 performance, to include additional target operational scenarios, additional submarine target types, and the assessment of the torpedo's final terminal homing and impact of the target (set-to-hit).
- Since safety concerns prevent using manned submarines for set-to-hit testing, the Navy developed an unmanned Steel Diesel Electric Submarine target. The Navy is using this surrogate for both set-to-hit and set-not-to-hit testing. The Steel Diesel Electric Submarine target has different signature characteristics than the UONS emerging threat, thus this surrogate is of limited utility in assessing torpedo operational performance for the UONS. However, completing set-to-hit terminal homing testing may address some unresolved test scenarios identified in the IOT&E. Mk 54 BUG performance in these previously unresolved test areas will affect the overall effectiveness and suitability of the torpedo against other submarine threats.
- The Navy did not complete adequate in-water developmental testing of the Mk 54 BUG. As the Program Office shifted resources to demonstrate that the Mk 54 BUG has a capability against the UONS emerging submarine threat, testing focused

on the UONS threat scenarios vice the operational scenarios for which the Mk 54 BUG was originally intended.

- To date, the Navy's emerging threat test scenario execution was structured so that attacking crews had near perfect knowledge of the target's location. In addition, the Navy conducted UONS testing in a relatively benign area that minimized torpedo interactions with the bottom or false contacts. Testing in these structured scenarios indicates the Mk 54 BUG likely has a limited capability against the Steel Diesel Electric Submarine surrogate target. The Mk 54 BUG performance in other environmental areas and against some operationally realistic target scenarios is being tested in FY12/13.
- The Navy is using a 1995 Operational Requirements Document, supplemented with sponsor clarification letters, as the reference to develop improvements and to test the Mk 54 torpedo upgrades. These documents are out of date and do not reflect the current threats, the current threat capabilities, or the current or desired torpedo performance.
- The operational realism of the Mk 54 BUG testing from fleet platforms suffers from significant test and safety limitations intended to prevent the Mk 54 from hitting the manned submarine target when it is dropped from an aircraft and due to time constraints for completing the testing. The time constraints associated with Mk 54 exercise torpedo employment and recovery often do not allow sufficient time for fully operationally realistic events.

Recommendations

- Status of Previous Recommendations. Two previous recommendations remain outstanding.
  1. The unresolved IOT&E of the Mk 54 terminal homing is superseded by changes to the Mk 54 BUG software; however, the updated terminal homing software will require a set-to-hit testing evaluation to resolve torpedo effectiveness.
  2. The Navy should continue to develop a lethality strategy that includes the firing of the Mk 54 against appropriate targets.
- FY12 Recommendations. The Navy should:
  1. Complete Mk 54 BUG OT&E in 2013. The testing should include scenarios against representative surrogates employing current threats, tactics, and torpedo countermeasures.
  2. Obtain an operationally realistic mobile set-to-hit target and complete the terminal homing testing of the Mk 54 torpedo.
  3. Investigate alternatives, such as the use of a portable range, to minimize or eliminate the test and safety limitations that minimize operational realism in Mk 54 testing.

Mobile User Objective System (MUOS)

Executive Summary

- The Navy successfully launched the first Mobile User Objective System (MUOS) satellite (MUOS-1) in February 2012, and conducted contractor and government developmental testing on the MUOS-1 legacy communications capability and primary and alternate control stations.
- The Navy's Commander, Operational Test and Evaluation Force (COTF) conducted a Multi-Service Operational Test and Evaluation (MOT&E) from August 15 – 29, 2012. Integrated developmental testing and preliminary analysis of operational testing indicate the MUOS-1 satellite is capable of providing legacy Ultra-High Frequency (UHF) communications to mobile users and the Navy is able to command and control the satellite over the MUOS primary and back-up telemetry, tracking, and commanding systems.
- Continuing challenges integrating the secure MUOS waveform onto the Joint Tactical Radio System (JTRS) Handheld, Manpack, and Small Form Fit (HMS) terminals may cause cost increases and schedule delays.

System

- MUOS is a satellite-based communications network designed to provide worldwide, narrowband, beyond line-of-sight, point-to-point, and netted communication services to multi-Service organizations of fixed and mobile terminal users. The Navy designed MUOS to provide 10 times the throughput capacity of the current narrowband satellite communications. The Navy intends for MUOS to provide increased levels of system availability over the current constellation of UHF follow-on satellites, as well as improved availability for small, disadvantaged terminals.
- MUOS consists of six segments:
  - The space transport segment consists of four operational satellites and one on-orbit spare. Each satellite hosts two payloads: a legacy communications payload that mimics the capabilities of a single UHF follow-on satellite, and a MUOS communications payload.
  - The Ground Transport Segment is designed to manage MUOS communication services and allocation of radio resources.
  - The Network Management Segment is designed to manage MUOS ground resources and allow for government controlled precedence-based communication planning.
  - The Ground Infrastructure Segment is designed to provide transport of both communications and command and control traffic between MUOS facilities and other communication facilities.
  - The Satellite Control Segment consists of MUOS Telemetry, Tracking, and Commanding facilities at the Naval Satellite Operations Center Headquarters and Detachment Delta.
  - The User Entry Segment provides a MUOS waveform hosted on MUOS-compatible terminals. The JTRS is responsible for developing and fielding MUOS-compatible terminals.

Mission

Combatant Commanders and U.S. military forces deployed worldwide will use the integrated MUOS satellite communications system to accomplish globally assigned operational and joint force component missions with increased operational space-based narrowband, beyond line-of-sight throughput, point-to-point, and netted communications services.

Major Contractor

- Lockheed Martin Space Systems – Sunnyvale, California
- General Dynamics C4 Systems – Scottsdale, Arizona

Activity

- The Navy successfully launched the MUOS-1 satellite on February 24, 2012. The contractor conducted orbital operations and contractor testing and transferred the MUOS-1 satellite to the government Program Office on June 21, 2012.
- The Navy conducted a government Technical Evaluation on the MUOS-1 and the Satellite Control Segment July 2 through August 1, 2012, in preparation for operational testing.

- COTF conducted MOT&E-1 on the satellite control capability and MUOS-1 legacy communications capability from August 15 – 29, 2012, in accordance with the DOT&E-approved Test and Evaluation Master Plan and test plan.
- The Navy completed MUOS- 2 satellite thermal vacuum testing and is preparing to ship the satellite in November 2012 for an anticipated launch in July 2013. The Navy plans to ship satellites #3, #4, and #5 in FY13, FY14, and FY15, respectively.
- The Navy operators have completed training and are commanding the MUOS-1 satellite at the Naval Satellite Operations Center in Point Mugu, California.
- The ground transport site preparation at Wahiawa, Hawaii; Geraldton, Australia; and Northwest, Virginia, is on schedule.
- The Navy's JTRS Network Enterprise Domain program is working to resolve integration problems associated with porting the secure MUOS waveform on the JTRS HMS Manpack radio.
- The MUOS program developed an end-to-end developmental test strategy incorporating additional testing prior to the MUOS MOT&E-2 and JTRS HMS FOT&E to discover and correct any integration problems prior to operational testing.
- The Navy plans to conduct the MUOS MOT&E-2 in the FY14 timeframe to operationally test the full MUOS capability.

Assessment

- Although analysis of the operational test data is ongoing, integrated developmental testing and preliminary analysis of operational testing suggest the MUOS-1 satellite is capable of providing legacy UHF communications to mobile users and the Navy is able to command and control the satellite over the MUOS primary and back-up systems.
- Challenges integrating the secure MUOS waveform onto the JTRS HMS terminals may cause cost increases and schedule delays to both programs. If the MUOS and JTRS program managers cannot resolve latency and reliability issues due to terminal processing constraints, the MUOS MOT&E-2 may be delayed.
- COTF cannot adequately test the MUOS capacity requirements in MOT&E-2 due to an insufficient number of JTRS-equipped mobile users. COTF will need to supplement MOT&E-2 data with validated modeling and simulation or other data to evaluate the system's ability to operate at its planned capacity and link availability levels.
- The MUOS Performance Model that will be used to model MUOS capacity is behind schedule and needs improvements to be accredited in time for MOT&E-2.

Recommendations

- Status of Previous Recommendations. The Navy adequately addressed two of the three previous recommendations. The remaining recommendation to operationally load the system for MOT&E-2 is no longer valid.
- FY12 Recommendation.
  1. The Navy should ensure adequate resources and expertise are applied to the MUOS Performance Model to make this a viable simulation to assess MUOS capacity requirements.

MQ-4C Triton Broad Area Maritime Surveillance (BAMS)

Executive Summary

- DOT&E approved the MQ-4C Triton Broad Area Maritime Surveillance (BAMS) Test and Evaluation Master Plan (TEMP) in January 2012 to guide system development and operational testing through an initial operational assessment and Milestone C Low-Rate Initial Production (LRIP) decision.
- The Navy postponed MQ-4C first flight and the start of developmental flight testing from May 2012 until at least January 2013 due to aircraft flight control computer software stability problems. Resulting test schedule revisions compress developmental and operational test events and significantly increase schedule risk prior to the planned operational assessment in June 2013 and the Milestone C decision in October 2013. The reduction in planned developmental testing means that evaluating the planned operational assessment is particularly critical to an informed production decision.
- The Navy began the Multi-Function Active Sensor (MFAS) radar payload risk-reduction flight test program in December 2011 using a Northrop Grumman surrogate test bed aircraft to identify and resolve potential radar performance problems prior to integration on the MQ-4C air vehicle.
- In June 2012, a Navy BAMS-Demonstrator (BAMS-D) aircraft crashed during a training mission near Patuxent River Naval Air Station, Maryland. The aircraft was one of five Air Force RQ-4A Global Hawk Block 10 aircraft acquired by the Navy to provide interim support for U.S. Central Command operations and develop unmanned maritime surveillance tactics and doctrine. This mishap did not affect the MQ-4C Triton development and test program.

System

- The MQ-4C Triton BAMS unmanned aircraft system is an Intelligence, Surveillance, and Reconnaissance system-of-systems consisting of the high-altitude, long-endurance MQ-4C air vehicle, sensor payloads, and supporting ground control stations. The MQ-4C system is a part of the Navy Maritime Patrol and Reconnaissance family-of-systems, with capabilities designed to complement the P-8A Poseidon.
- The MQ-4C air vehicle design is based on the Air Force RQ-4B Global Hawk air vehicle with significant modifications that include strengthened wing structures, anti-ice and de-icing systems, and an air traffic de-confliction and collision avoidance radar system.

- The MQ-4C is equipped with the MFAS maritime surveillance radar to detect, identify, and track surface targets and produce high-resolution imagery. The BAMS Electro-Optical Infrared Sensor provides full motion video and still imagery of surface targets. An Electronic Support Measures system detects, identifies, and geo-locates radar threat signals. An Automatic Identification System (AIS) receiver permits the detection, identification, geo-location, and tracking of cooperative vessels equipped with AIS transponders.
- Onboard line-of-sight and beyond line-of-sight datalink systems transmit sensor data from the air vehicle to ground control stations for dissemination to fleet tactical operation centers and intelligence exploitation sites.

Mission

- Commanders use units equipped with MQ-4C to conduct maritime surveillance operations and provide high-altitude, long-endurance intelligence collection.
- MQ-4C operators detect, identify, track, and assess maritime and littoral targets of interest and collect imagery and signals intelligence information. Operators disseminate sensor data to fleet units to support a wide range of maritime missions to include surface warfare, intelligence operations, strike warfare, maritime interdiction, amphibious warfare, homeland defense, and search and rescue.

Major Contractor

Northrop Grumman Aerospace Systems, Battle Management and Engagement Systems Division – Bethpage, New York

Activity

- DOT&E approved the MQ-4C TEMP in January 2012 to guide system development and operational testing through an initial operational assessment and Milestone C LRIP decision.
- The Navy postponed MQ-4C first flight and the start of developmental flight testing from May 2012 until at least December 2012 due to aircraft mission computer software stability problems.
- The program also deferred development and testing of some air vehicle and sensor capabilities until after Milestone C in order to reduce current test schedule pressures. The program is currently assessing the potential effect of these deferrals on post-Milestone C test schedules leading to the planned IOT&E in FY15.
- In June 2012, the first MQ-4C developmental test aircraft began initial ground test activities leading to first flight.
- The Navy began MFAS radar payload risk-reduction flight test program in December 2011 using a Northrop Grumman surrogate test bed aircraft to identify and resolve potential radar performance problems prior to integration on the MQ-4C air vehicle.

Assessment

- The MQ-4C program experienced a significant test schedule delay in 2012, primarily due to aircraft flight control computer software stability problems discovered during laboratory testing. These problems delayed first flight of the MQ-4C developmental test aircraft from May 2012 until at least January 2013. The revised program test schedule compresses developmental and operational test events and significantly increases schedule risk prior to the planned operational assessment in June 2013 and the Milestone C decision in October 2013. If developmental flight testing identifies any significant air vehicle, ground station, or mission system deficiencies, additional program schedule delays are possible.
- Following delivery of the first flight test air vehicle in June 2012, acceptance and ground testing proceeded more slowly than expected. Additional ground test delays encountered in early FY13 may result in further delays in the flight test program.
- The MFAS radar risk-reduction flight test program progressed more slowly than the Navy expected in FY12. The program is currently focusing MFAS flight test activities on improving identified sensor software stability, maritime target detection and tracking consistency, and radar image quality issues.
- In June 2012, a Navy BAMS-D aircraft crashed during a training mission near Patuxent River Naval Air Station, Maryland. The aircraft was one of five Air Force RQ-4A Global Hawk Block 10 aircraft acquired by the Navy to provide interim support for U.S. Central Command operations and develop unmanned maritime surveillance tactics and doctrine. BAMS-D airframe design, aircraft systems, and sensor payloads differ significantly from the more advanced MQ-4C Triton system that will begin flight test in FY13. This mishap did not affect the MQ-4C Triton development and test program.

Recommendations

- Status of Previous Recommendations. This is the first annual report for this program.
- FY12 Recommendation.
  1. The Navy should fully implement the event-driven test and evaluation strategy outlined in the January 2012 TEMP to ensure that the program completes the previously approved system maturity demonstrations and operational assessments prior to a Milestone C LRIP decision. Given the reductions in developmental testing that are occurring, the operational assessment will be a key, critical source of information on the system's performance prior to the production decision.

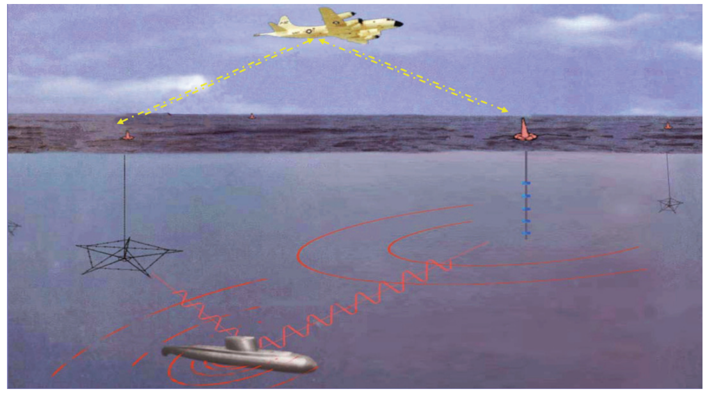
Multi-Static Active Coherent (MAC) System

Executive Summary

- DOT&E placed the Multi-Static Active Coherent (MAC) program on oversight in 2012. MAC will be the primary wide-area acoustic search system for the P-8A; without it, P-8A has limited large-area Anti-Submarine Warfare (ASW) search capability.
- The Navy conducted developmental testing in 2012; the Navy plans to begin operational testing in early FY13.

System

- The MAC system is an active sonar system composed of two types of buoys (source and receiver) and an acoustic processing software suite. It is employed by the Navy's maritime patrol aircraft (P-3Cs and eventually P-8As) to search for and locate threat submarines in a variety of ocean conditions.
- MAC is an upgrade to the Navy's current Improved Extended Echo Ranging (IEER) system, which employs non-coherent sources to produce loud sounds that reflect off submarine targets; these echoes are then detected by receiver buoys. MAC employs the same receiver buoys, but uses new coherent source buoys that enables multiple pings, optimized waveforms, and various ping durations, none of which the legacy IEER system provided.
- The Navy intends to initially employ MAC on P-3Cs in a limited set of acoustic environments. Future increments of MAC will be employed on P-8A and in a wider variety of acoustic ocean environments in order to span the operational envelope of threat submarine operations.



- MAC is expected to have fewer effects on marine mammals and the environment than the legacy IEER system.
- MAC will be the primary wide-area acoustic search system for the P-8A.

Mission

The Navy intends for P-3C and P-8A crews equipped with MAC to support the search, detect, and localization phases of the ASW mission. MAC is particularly focused on large-area active acoustic searches for threat submarines.

Major Contractors

- Lockheed Martin Corporation – Manassas, Virginia
- Sparton Electronics Florida, Inc. – De Leon Springs, Florida
- Ultra Electronics, Undersea Sensor Systems Incorporated (USSI) – Columbia City, Indiana

Activity

- DOT&E placed the MAC program on oversight in 2012. The Navy intends MAC to be a primary system for the successful ASW mission performance of the Maritime Patrol P-3 aircraft and the new P-8A aircraft. Because of technical difficulties integrating multi-static active wide-area ASW search systems, the Navy deferred the P-8A Maritime Patrol aircraft's wide-area search requirements and deferred this testing on P-8A.
- MAC achieved Milestone C in March 2012. DOT&E did not approve the program's Test and Evaluation Master Plan (TEMP) since it was written prior to DOT&E's oversight; however, DOT&E accepted the current Navy TEMP as adequate for MAC's IOT&E. An update to the TEMP is required to plan for future MAC upgrades and for the implementation of MAC on the P-8A.
- The program conducted developmental and integrated testing on P-3C aircraft in the summer of 2012; DOT&E is evaluating the data collected.
- The Navy reported the Active System Performance Estimate Computer Tool (ASPECT)/Multi-static Planning Acoustics Toolkit (MPACT) used for MAC mission planning inaccurately predicts MAC search probability of detection. The Navy also reported that the current aircraft system's tactical mission software for determining the position of the Air Deployable Active Receiver sonobuoys and aircraft Mark-on-Top tactical procedures were not sufficient to maintain geographically accurate sonobuoy locations throughout the MAC search field. The sonobuoy location inaccuracy is caused by the variable currents and resulting buoy drift rates encountered in the large ocean search field. In October 2012, the Navy waived these deficient conditions for the MAC IOT&E.
- The Navy will begin MAC operational testing on P-3C aircraft in early FY13. The Navy began test planning for the integration of MAC onto P-8A as well as planning for the testing of a future upgrade to the MAC system in late FY12.

Assessment

- Based on the limited developmental testing data available to date, the reliability of the buoys and the software appear to be meeting developmental test requirements. The Navy and DOT&E will evaluate final configuration changes to the system during IOT&E.
- The IOT&E will not fully examine the capability of MAC across all operational conditions, operational environments, and target types; additional testing is necessary once MAC is integrated onto P-8A operational systems to examine performance under other conditions. Additional testing is also required to examine planned system upgrades.
- The inaccurate ASPECT/MPACT probability of detection prediction tool used for MAC and the inaccurate sonobuoy locating systems will likely affect the MAC system's mission performance and the ability of the system to accurately locate submarine targets. These inaccuracies could result in operators installing a MAC search field that is not optimized based on the environmental conditions for detecting the target in the required search area. The buoy location inaccuracies will affect the crew's ability to efficiently and accurately locate the target. Additional testing is required to assess the impact of these waived conditions.
- Based on the initial scope of the system's capabilities, the planned IOT&E will allow an assessment of MAC performance in some threat areas and against nuclear submarine targets. DOT&E requires future testing to determine performance against diesel electric submarine targets and in the variety of threat environmental conditions where the Navy intends to employ the MAC system.

Recommendations

- Status of Previous Recommendations. This is the first annual report for this program.
- FY12 Recommendation.
  1. Update the MAC TEMP to include sufficient testing in other operational conditions, operational environments, and against diesel-electric submarines. The TEMP should include planned testing on both P-3C and P-8A.

MV-22 Osprey

Executive Summary

- The Navy conducted FOT&E in June 2012.
- The Navy's Commander, Operational Test and Evaluation Force evaluated capabilities of the latest Block C software and six other minor enhancements.
- Testing demonstrated the utility of all new enhancements with the exception of the Traffic Advisory System (TAS). Intended to warn pilots of impending collision with approaching aircraft, the TAS does not distinguish between approaching aircraft and aircraft in formation. Additional development is needed to address operational test findings and improve the utility of TAS for the MV-22 fleet.
- The Block C aircraft demonstrated improved reliability, availability, and maintainability compared to Block B aircraft performance in previous operational tests. The MV-22 has met all RAM requirements in the Capability Production Document.
- The Navy continues to execute a viable reliability growth program for the MV-22 fleet.

System

- There are two variants of the V-22: the Marine Corps MV-22 and the Air Force/U.S. Special Operations Command CV-22. The air vehicles for Air Force and Marine Corps missions are nearly identical, with common subsystems and military components sustainable by each Service's logistics system.
- The Marine Corps is replacing the aging CH-46 and CH-53D helicopters with MV-22s. The MV-22 is a tilt rotor aircraft capable of conventional wing-borne flight and vertical take-off and landing.
- The MV-22 can carry 24 combat-equipped Marines and operate from ship or shore. It can carry an external load up to 10,000 pounds over 40 nautical miles ship-to-shore and return, and can self-deploy 2,267 nautical miles with a single aerial refueling.
- Block C (software version C1.01) enhancements include:
  - Redesigned Environmental Control System (ECS), which enhances system reliability and improves cabin cooling using directional nozzles, larger heat exchangers, and a new ECS controller.
  - Electronic Standby Flight Instruments (ESFI), which replace the analog standby instrument cluster.
  - Color Weather Radar System, which provides weather detection, ground mapping, and sea search functions.
  - Day Heads-up Display (HUD), which provides basic flight and performance instrument information in a helmet-mounted monocle.
  - TAS, which is intended to warn MV-22 pilots of other aircraft in close proximity or with the potential for collision.
  - Cabin Situational Awareness Device, which displays essential mission information to troop commanders in the cabin and assists the troop commander to communicate with Marines independent of the aircrew.

Mission

- Squadrons equipped with MV-22s will provide medium-lift assault support in the following operations:
  - Ship-to-Objective Maneuver
  - Sustained operations ashore
  - Tactical recovery of aircraft and personnel
  - Self-deployment
  - Amphibious evacuation
- Currently deployed squadrons are providing high-tempo battlefield transportation in Iraq and Afghanistan.

Major Contractors

Bell-Boeing Joint Venture:

- Bell Helicopter – Amarillo, Texas
- The Boeing Company – Ridley Township, Pennsylvania

Activity

- The Navy conducted FOT&E in June 2012 in accordance with the DOT&E-approved plan. This dedicated operational test was preceded by about 8 months of integrated testing in which MV-22 aircraft accumulated 320 flight hours. During operational test, aircraft accumulated approximately 67 flight hours.

- Commander, Operational Test and Evaluation Force evaluated capabilities of the latest Block C enhancements: software version C1.01, upgraded ECS, ESFI, Color Weather Radar System, Day HUD, TAS, and Cabin Situational Awareness Device upgrades.
- VMX-22 conducted all operational test missions at or near the Marine Corps Air Station New River, North Carolina, using four production-representative aircraft (two Block C aircraft and two Block B aircraft). DOT&E observed as passengers on all of the operational test missions.

Assessment

- Except for minor functionality upgrades, software version C1.01 is identical to the existing Block B software. DOT&E noted no degradation in existing capability during testing.
- The upgraded ECS proved effective at cooling troops in the cabin. The adjustable nozzles allow troops to direct cool/warm air onto their head/neck. In surveyed responses, 78 percent of Marines in a cabin with upgraded ECS described their general comfort during missions as good or excellent versus 45 percent of those in a cabin without the upgraded ECS.
- The ESFI was well mechanized and integrated into the cockpit with over 75 percent of survey responses indicating adequate visibility of ESFI, and about 65 percent noting the ESFI was effective for management of flight profile during basic instrument maneuvering. Pilots noted a lag in the Vertical Velocity Indicator of about 1 to 5 seconds, which makes altitude management difficult.
- The Color Weather Radar provided accurate weather information to include precipitation intensity and storm cell turbulence. The system clearly defined terrain features along coastlines out to 20 nautical miles, and easily detected ships in sea search mode. The location and integration of the Color Weather Radar was not ideal. The radar display and controls are accessible only to the right seat pilot, and the pilot must dedicate one of two multi-functional displays to view the weather radar.
- The Day HUD enhances the pilot's situational awareness during tactical situations and reduced visibility conditions.
- Troop commanders said the Cabin Situational Awareness Display enhances situational awareness. Access to GPS updates for handheld devices, way points, flight plans, location, and other mission information increased commanders' confidence in knowing their location on leaving the aircraft and their ability to navigate the terrain once disembarked.
- Testing demonstrated the lack of utility of the TAS. This system displays the top three traffic advisory priorities by calculating the bearing, range, and altitude of nearby aircraft. These top three priorities include other aircraft in formation, essentially rendering the advisory information useless in most MV-22 multi-aircraft missions.
- The Block C aircraft demonstrated improved reliability, availability, and maintainability relative to aircraft in previous operational tests and the MV-22 fleet, and met requirements for reliability, availability, and maintainability.
- An analysis of reliability data from 2008 to 2012 revealed that integrated wiring systems in engine nacelles have high failure rates from intrusion of sand and oil, causing internal chafing and deterioration of insulated coatings. PMA-275 has funded a program to redesign and replace 13 wiring bundles to improve wiring system reliability and repairability.
- No additional flight testing or engineering analysis have been done indicating a change would be appropriate to DOT&E's September 2005 assessment that the MV-22 cannot perform autorotation to a survivable landing.

Recommendations

- Status of Previous Recommendations. The Navy has made improvements and has plans to make other reliability improvements to the icing protection system, as recommended in FY11. The Navy should conduct operational testing in icing conditions when all icing protection system enhancements are completed.
- FY12 Recommendations. The Navy should:
  1. Continue development and testing to improve overall MV-22 reliability, availability, and maintainability with particular emphasis on the flight controls, integrated wiring, and drive train subsystems.
  2. Withhold fielding the TAS as implemented in FOT&E. Additional development is needed to address operational test findings and improve the utility of TAS for the MV-22 fleet.

Navy Multiband Terminal (NMT)

Executive Summary

- The Navy's Commander, Operational Test and Evaluation Force (COTF) conducted the Navy Multiband Terminal (NMT) IOT&E from July 20 through August 19, 2011, on two surface ships, one submarine, a shore site, and various supporting sites.
- The NMT met requirements to provide legacy Extremely High Frequency (EHF) communications over Milstar and Ultra High Frequency Follow-On EHF Enhanced payloads; X-band over the legacy Defense Satellite Communication System and Wideband Global System (WGS); and Ka-Band over WGS.
- When the IOT&E showed that NMT is not operationally suitable, the NMT program manager performed root cause analyses and undertook corrective actions to correct deficiencies found during the IOT&E and improve suitability.
- COTF conducted further operational testing from June 1 through August 1, 2012, to verify that the deficiencies had been corrected. The testing included two surface ships and one shore site, operating under realistic conditions. The NMT is now operationally suitable.

System

- The NMT system is the next-generation maritime military satellite communications terminal for the Navy and its coalition partners; the Navy uses it for enhancing protected and survivable satellite communications.
- The NMT is interoperable with the legacy service satellite communications terminals, including the Follow-on Terminal and Navy EHF Satellite Program.
- The NMT has variants for surface ships, submarines, and shore sites. The NMT system variants have two major component groups: the Communications Group and the Antenna Group.
- The Communications Group includes the following:
  - Operator User Interface
  - Power Distribution Unit
  - Keyboard
  - EHF and Wideband drawers
  - Prime Power Interface
- The Antenna Group varies across different platforms and includes new, reused, and modified antennas to support the required Q- and Ka-Bands, as well as X-band with Global Broadcasting System.
- The key features of the NMT system are:
  - Open system architecture
  - Full compatibility with legacy terminal components
  - High commonality, reliability, and effective fault isolation
  - Mission Planning capability

Mission

The Navy Component Commander uses the NMT to provide secure, protected, and survivable connectivity across the spectrum of mission areas including land, air, and naval warfare; special operations; strategic nuclear operations; strategic defense; theater missile defense; and space operations and intelligence.

Major Contractor

Raytheon Net-Centric Systems – Marlboro, Massachusetts

Activity

- COTF conducted the NMT IOT&E from July 20 through August 19, 2011, on two surface ships, one submarine, a shore site, and various supporting sites. COTF executed the test in accordance with the DOT&E-approved Test and Evaluation Master Plan and test plan.
- The Assistant Secretary of the Navy (Research, Development, and Acquisition) authorized the NMT Program Office to procure FY12 quantities of 26 NMTs in support of the program and an additional 24 NMTs in support of other programs such as foreign military sales.

- The NMT program manager performed root cause analyses and undertook corrective actions to correct deficiencies found during the IOT&E.
- COTF conducted further operational testing from June 1 through August 1, 2012, to verify that the deficiencies had been corrected. The testing included two surface ships and one shore site, operating under realistic conditions.
- The Navy plans to conduct a Full-Rate Production Decision Review for NMT in November 2012.
- COTF plans to conduct an FOT&E in 3QFY14 to test the NMT's ability to operate over Advanced EHF satellites using the extended data rate waveform.

Assessment

- NMT can meet requirements to provide legacy EHF communications over Milstar and Ultra High Frequency Follow-On EHF Enhanced payloads; X-band over the legacy Defense Satellite Communication System and WGS; and Ka-Band over WGS. NMT also demonstrated the capability to receive Global Broadcast System broadcasts over WGS.
- The FY11 IOT&E demonstrated that the NMT is not operationally suitable. Deployed ships' communications could be hampered by poor reliability and long repair times when compared to the Navy's requirements. The time needed to repair the NMT when spare parts were unavailable resulted in long periods of degraded operations or complete outages either for a specific communications band or for the entire NMT system during IOT&E.
- During the recent operational test to verify corrections of deficiencies observed during IOT&E, the NMT demonstrated a Mean Time Between Critical Failure of 1,461 hours for surface ship variants and 701 hours for shore variants against a requirement of 1,400 hours. The low reliability for shore variants is due to software problems with the operator interface that require system reboots to restore the NMT to operation. These reboots temporarily disrupted communications. The operational consequences were mitigated by the availability of redundant Q-band terminals and the ability to shift communications between terminals. The corrective actions taken by the program manager improved suitability. The NMT is now operationally suitable.
- The recent operational test demonstrated that improvements to NMT logistic support are still required for deployed ships. The NMT was capable of adequately supporting shore sites and ships in port. Off-board logistics delay time for a ship deployed in the Mediterranean was 287 hours against a requirement of 100 or less hours.
- The Navy may not identify additional risks, other than those observed during the IOT&E, until the FOT&E when Advanced EHF modes of operation, including the new extended data rate waveform and the new Mission Planning System, will be tested. These capabilities were not evaluated during the IOT&E because they depend on capabilities being delivered by the Advanced EHF program on a different timeline.

Recommendations

- Status of Previous Recommendations. The Navy has made satisfactory progress on all previous recommendations.
- FY12 Recommendations. The Navy should:
  1. Synchronize the NMT FOT&E with the Air Force's Advanced EHF Multi-Service Operational Test and Evaluation to efficiently use test resources.
  2. Continue to explore methods to improve logistic supportability for deployed ships prior to the FY14 FOT&E.
  3. Correct the operator interface errors that are reducing shore site reliability.

P-8A Poseidon Multi-Mission Maritime Aircraft (MMA)

Executive Summary

- The Navy delayed the P-8A IOT&E from February 2012 to September 2012 to develop and test a series of mission system software improvements intended to correct significant radar, electro-optical/infrared (EO/IR) sensor, Electronic Support Measures (ESM), and communications system performance deficiencies identified during developmental testing.
- In August 2012, the Navy completed development of Operational Flight Program (OFP) Release 9.3 and approved it as the IOT&E software baseline. Developmental test results indicate that OFP Release 9.3 improved system performance, particularly for the ESM sensor. However, it did not resolve a number of other deficiencies that could degrade operational effectiveness for all P-8A missions. These deficiencies pose a high risk to operational effectiveness, particularly in the Intelligence, Surveillance, and Reconnaissance (ISR); Command, Control, and Communication; and Joint Interoperability mission areas. Unresolved sensor performance deficiencies also affect the primary Anti-Submarine Warfare (ASW) mission.
- P-8A ASW sonobuoy acoustic processing and torpedo carriage/release systems continued to mature during developmental test events, despite recurring system stability and reliability problems.
- The Navy's decision to waive P-8A wide-area acoustic search requirements for IOT&E and defer integration of a multi-static active acoustic capability until at least FY14 will limit ASW mission effectiveness in the near-term. In order to achieve full ASW mission capability on the P-8A aircraft, the Navy will have to complete future integration of the Multi-Static Active Coherent broad area acoustic system on the aircraft. P-8A airframe and aircraft subsystem maturity improved during developmental test events. Remaining weather, take-off, and flight envelope restrictions will not significantly affect mission operations. However, main tank fuel overheating during ground and low-level flight will limit ASW operations in hot weather environments.
- P-8A system reliability approached the minimum operational requirement of 11.7 Mean Flight Hours Between Operational Mission Failure during the OFP Release 9.3 developmental test phase just prior to IOT&E. While promising, this reliability assessment was inconclusive due to the small number of operating hours observed with OFP Release 9.3 installed. The IOT&E results will provide a more complete assessment of system reliability.
- The P-8A live fire test program completed an initial assessment of P-8A vulnerabilities for a range of ballistic projectiles. DOT&E requires completion of remaining vulnerability test events on the S-1 static test article to support completion of the P-8A IOT&E report in advance of the July 2013 Full-Rate Production decision.

- The Navy did not release the P-8A On-Board Inert Gas Generating System (OBIGGS) for operational testing due to serious system design deficiencies discovered during developmental testing. The program is currently evaluating design changes and will conduct further developmental testing in late FY12 and early FY13.

System

- The P-8A Poseidon Multi-mission Maritime Aircraft (MMA) design is based on the Boeing 737-800 aircraft with significant modifications to support Navy maritime patrol mission requirements. It will replace the P-3C Orion.
- The P-8A incorporates an integrated sensor suite that includes radar, electro-optical, and electronic signal detection sensors to detect, identify, locate, and track surface targets. An integrated acoustic sonobuoy launch and monitoring system detects, identifies, locates, and tracks submarine targets. The P-8A carries Mk 54 torpedoes and is currently integrating the AGM-84 Harpoon missile system to engage identified submarine and surface targets. Sensor systems also provide tactical situational awareness information for dissemination to the fleet and ISR information for exploitation by the joint intelligence community.
- The P-8A aircraft incorporates aircraft survivability enhancement and vulnerability reduction systems. An integrated infrared missile detection system, flare dispenser, and directed infrared countermeasure system is designed to improve survivability against infrared missile threats. On and off-board sensors and datalink systems are used to improve tactical situational awareness of radio frequency missile threat systems. Fuel tank inerting and fire protection systems reduce aircraft vulnerability.

Mission

- Theater Commanders primarily use units equipped with the P-8A MMA to conduct Anti-Submarine Warfare. P-8A units detect, identify, track, and destroy submarine targets.
- Additional P-8A maritime patrol missions include:
  - Anti-Surface Warfare operations to detect, identify, track, and destroy enemy surface combatants or other shipping targets.
  - Maritime and littoral ISR operations to collect and disseminate imagery and signals information for exploitation by the joint intelligence community.
  - Collection and dissemination of tactical situation information to improve the fleet common operational picture.
  - Identification and precise geo-location of targets ashore to support fleet strike warfare missions.

Major Contractor

Boeing Defense, Space, and Security – St. Louis, Missouri

Activity

- The Navy delayed the P-8A IOT&E from February 2012 to September 2012 to develop and test a series of mission system software improvements intended to correct significant radar, EO/IR sensor, ESM, and communications system performance deficiencies identified during developmental testing.
- From May 2012 to September 2012, Navy operational testers conducted a series of pre-IOT&E integrated developmental and operational test events using production-representative test aircraft and interim OFP software releases to evaluate P-8A deployment capabilities and assess evolving aircraft and mission system maturity. These events also provided additional flight crew and maintenance training experience in preparation for IOT&E. Major integrated test events included:
  - Joint Warrior fleet exercise conducted with the United Kingdom and other NATO countries in April 2012. Test crews completed 6 missions totaling 36.3 flight hours during this exercise.
  - U.S.–Australian fleet exercise in Australia in June 2012. Operational test crews completed 6 missions totaling 24.8 flight hours during this exercise.
  - Rim of the Pacific fleet exercise in Hawaii in July 2012. Operational test crews completed 20 missions totaling 102.2 flight hours during this exercise.
  - Mk 54 torpedo tests at the Atlantic Underwater Test Center in May 2012, Cape Cod Atlantic test areas in August 2012, and Hawaii Pacific test ranges in September 2012.
- In August 2012, the Navy completed development of OFP Release 9.3 and approved it for use in IOT&E. This release addressed some of the most serious sensor performance and communications system deficiencies identified during earlier testing.
- The Navy entered IOT&E beginning with participation in the U.S. Pacific Command Valiant Shield exercise in early September 2012. The Navy plans to complete IOT&E in December 2012. The Navy is conducting testing in accordance with the DOT&E-approved test plan.
- The P-8A live fire test program completed ballistic testing of P-8A emergency oxygen bottles on a surrogate Boeing 737 test aircraft in March 2012. The program also completed an evaluation of wing fuel tank tolerance against threat-induced hydrodynamic ram damage in September 2012.
- The Navy completed an initial flight test of the missile warning system, flare dispenser, and directed infrared countermeasures system against simulated infrared threats. The program is planning to conduct additional hardware-in-the-loop testing of these systems in early FY13 to complete required live fire and operational test requirements.

Assessment

- Developmental test results indicate P-8A airframe and aircraft subsystem maturity continued to improve as the developmental test program progressed. Remaining aircraft weather, take-off, and flight envelope restrictions should not significantly affect mission operations and are on track for resolution prior to P-8A operational deployment. However, developmental testing identified main tank fuel overheating during ground and low-level flight operations as a serious deficiency that will limit ASW mission on-station time in hot weather environments.
- Developmental test results indicate that OFP Release 9.3 improved system performance, particularly for the ESM sensor. However, it did not resolve a number of other deficiencies that could seriously degrade operational effectiveness for all P-8A missions. These deficiencies pose a high risk to operational effectiveness, particularly in the ISR; Command, Control, and Communication; and Joint Interoperability mission areas:
  - Common Data Link and International Maritime Satellite data transfer deficiencies that prevent reliable transmission of synthetic aperture radar (SAR) and EO/IR imagery intelligence products to operational users
  - Ineffective voice satellite communications systems that prevent transmission and receipt of mission critical information
  - SAR high-resolution image quality problems that degrade imagery intelligence capabilities
  - Radar pointing errors that prevent effective SAR imagery collection for some littoral/land targets

- EO/IR sensor cross-cue errors and inoperative auto-track modes that significantly increase sensor operator workload
- Non-standard imagery metadata formats that prevent joint intelligence exploitation of P-8A imagery intelligence products
- Ineffective ESM Specific Emitter Identification subsystem that does not reliably collect and identify emitter signatures to enable identification of specific hostile targets
- Radar track-while-scan deficiencies that degrade P-8A and fleet situational awareness

- P-8A ASW sonobuoy launch, positioning, and acoustic processing systems continued to mature during developmental test events, despite recurring system stability and reliability problems. Unresolved radar, EO/IR, and ESM sensor performance deficiencies also affect ASW mission operations. Excessive ESM system interference and bleed over onto ASW operator displays frequently preclude ESM operation during ASW operations. In addition, developmental test events included few ASW search and detect events against operationally realistic submarine targets, which increases the potential for discovery of additional deficiencies during IOT&E.
- The Navy decision to waive P-8A wide-area acoustic search requirements for IOT&E and defer integration of a multi-static active acoustic capability until at least FY14 will limit ASW mission effectiveness in the near-term. Future integration of the Multi-Static Active Coherent broad area acoustic system will be required to achieve full ASW mission capabilities.
- Developmental test results indicate that P-8A torpedo release and water impact point accuracies meet operational requirements. Complete end-to-end torpedo employment effectiveness will be assessed during IOT&E events. However, inadequate weapons bay heating systems currently restrict torpedo carriage altitudes and combat mission radius in cold weather environments. The program is planning to develop and test system design changes to improve weapons bay heating in FY13, prior to operational fielding.
- P-8A system reliability improved significantly during the final OFP Release 9.3 developmental test phase prior to IOT&E, approaching the minimum operational requirement of 11.7 Mean Flight Hours Between Operational Mission Failure. While promising, this pre-IOT&E reliability assessment was inconclusive due to the small number of operating hours observed with OFP Release 9.3 installed. Most P-8A mission reliability failures are directly attributable to system software deficiencies. Hardware reliability exceeded the 1.25 Mean Flight Hour Between Operational Mission Failure requirement throughout the developmental and integrated test phases.
- The P-8A live fire test program completed an initial assessment of P-8A vulnerabilities for a range of ballistic projectiles. DOT&E requires completion of remaining vulnerability test events on the S-1 static test article to support completion of the P-8A IOT&E report in advance of the July 2013 Full-Rate Production (FRP) decision. The current S-1 test schedule supports a live fire vulnerability assessment in 3QFY13, but with little margin for additional delay prior to the planned July 2013 FRP decision.
- The Navy did not release the P-8A OBIGGS for operational testing during IOT&E due to serious system design deficiencies discovered during developmental testing. The program is currently implementing design changes and has begun further developmental testing, which will continue into FY13. This system is a critical P-8A survivability feature that maintains inert fuel tank environments to improve ballistic projectile protection.

Recommendations

- Status of Previous Recommendations. The Navy made progress on all FY11 recommendations. Developmental testing cleared the P-8A operational flight envelope to support IOT&E operational flight profiles. The program realigned S-1 live fire test schedules to support completion of testing prior to the FRP decision. The Navy corrected many, but not all, mission critical software deficiencies during the FY12 extended developmental test period leading to IOT&E.
- FY12 Recommendations. The Navy should:
  1. Accelerate correction of the remaining unresolved radar, EO/IR, ESM, and communications/data transfer deficiencies and conduct operational testing to verify software fix effectiveness.
  2. Correct weapons bay heating and main tank fuel overheating hardware deficiencies and conduct testing to verify unrestricted flight envelopes in cold and hot weather environments.
  3. Closely monitor progress of live fire vulnerability and OBIGGS test events to ensure completion and data delivery in time to support DOT&E's P-8A IOT&E report and FRP Decision.
  4. Complete Test and Evaluation Master Plan development and test planning for P-8A Increment 1 FOT&E events and the series of P-8A Increment 2 developmental and operational tests scheduled to begin in FY14.

Ship Self-Defense

Executive Summary

- The ship self-defense mission for aircraft carriers, destroyers, and amphibious warfare ships coordinates several legacy shipboard systems, as well as five major acquisition programs: Ship Self-Defense System (SSDS), Rolling Airframe Missile (RAM), Evolved SeaSparrow Missile (ESSM), Cooperative Engagement Capability (CEC), and the Air and Missile Defense Radar (AMDR). These comprise a self-defense capability for in-service ships, as well as the LPD-17, LHA-6, DDG-51 Flight III, and CVN-78 ship classes still in acquisition.
- DOT&E issued a classified report to Congress in November 2012 entitled "Ship Self-Defense Operational Mission Capability Assessment Report."
- While the integration of sensor and weapon systems with the command and decision system enhances the ships' self-defense capability over non-integrated combat systems, the Navy has not successfully demonstrated the ability to effectively complete the self-defense mission against the types of threats and threat scenarios for which the overall system was designed.
- The Navy must complete the currently planned operational test program and conduct additional testing to demonstrate the correction of significant deficiencies with SSDS Mk 2, RAM, ESSM, CEC, and legacy ship self-defense combat system elements.

System

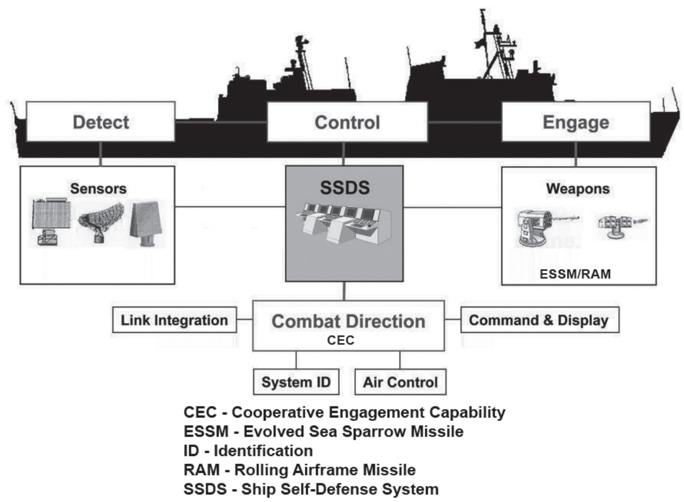
Surface ship self-defense is addressed by several legacy combat system elements (ship class-dependent) and five acquisition programs: SSDS, RAM, ESSM, CEC, and AMDR.

SSDS

- SSDS is a local area network that uses open computer architecture and standard Navy displays to integrate a surface ship's sensors and weapons systems to provide an automated detect-track-engage sequence for ship self-defense. SSDS Mk 1 is the command and control system for LSD-41/49 class ships.
- SSDS Mk 2 has six variants:
  - Mod 1, used in CVN-68 class aircraft carriers
  - Mod 2, used in LPD-17 class amphibious ships
  - Mod 3, used in LHD-7/8 class amphibious ships
  - Mod 4, in development for LHA-6 class amphibious ships
  - Mod 5, in development for LSD-41/49 class amphibious ships
  - Mod 6, in development for CVN-78 class aircraft carriers

RAM

- The RAM, jointly developed by the United States and the Federal Republic of Germany, provides a short-range, lightweight, self-defense system to defeat Anti-Ship Cruise Missiles (ASCMs). RAM is currently installed in all aircraft carriers and amphibious ships (except LPD-4 class).
- There are four RAM variants:
  - RAM Block 0 uses dual mode, passive radio frequency/infrared guidance.
  - RAM Block 1 adds infrared guidance improvements to extend defense against non-radio-frequency-radiating ASCMs.
  - RAM Block 1A extends the capability of RAM Block 1 against non-ASCM targets including helicopters, slow aircraft, and surface threats.
  - RAM Block 2 is in development and will extend the capability of RAM Block 1A against newer classes of ASCM threats.



ESSM

- The ESSM, cooperatively developed among 13 nations, is a medium-range, ship-launched self-defense guided missile designed to defeat ASCM, surface, and low velocity air threats. The ESSM is currently installed on DDG-51 Flight IIA destroyers, as well as CVN-68 class aircraft carriers equipped with the SSDS Mk 2 Mod 1 Combat System. The Navy is planning for future ESSM installations in CG-47 class cruisers, LHA-6 class amphibious assault ships, CVN-78 class aircraft carriers, DDG-1000 class destroyers, and DDG-51 Flight III class destroyers.
- There are two variants of ESSM.
  - ESSM Block 1 is a semi-active radar-guided missile that is currently in-service.
  - ESSM Block 2 is in development and will have semi-active radar-guidance as well as active radar-guidance.

CEC

- CEC is a sensor network with integrated fire control capability that is intended to significantly improve battle force air and missile defense capabilities by combining data from multiple battle force air search sensors on CEC-equipped units into a single, real-time, composite track picture. The two major hardware pieces are the Cooperative Engagement Processor, which collects and fuses radar data, and the Data Distribution System, which exchanges the Cooperative Engagement Processor data. CEC is an integrated component of, and serves as the primary air tracker for, SSDS Mk 2-equipped ships.
- There are four major variants of CEC:
  - The CEC USG-2 is used in selected Aegis cruisers and destroyers, LPD-17/LHD amphibious ships, and CVN-68 class aircraft carriers.
  - The CEC USG-2A, an improved version of the USG-2, is used in selected Aegis cruisers and destroyers.
  - The CEC USG-3 is used in the E-2C Hawkeye 2000 aircraft.
  - The CEC USG-3B is in development for use in the E-2D Advanced Hawkeye aircraft.

AMDR

- The AMDR is the Navy's next generation radar system that is being developed to provide DDG-51 Flight III Destroyer combat systems with simultaneous sensor support of ballistic missile defense (BMD) and air defense (AD) (to include self-defense) missions.

Mission

Naval Component Commanders use SSDS, RAM, ESSM, and CEC, as well as many legacy systems, to provide faster, more effective accomplishment of ship self-defense missions.

- Naval surface forces use SSDS to provide automated and integrated detect-to-engage ship self-defense capability against ASCM, air, and surface threats.
- Naval surface forces use RAM to provide a short-range hard kill engagement capability against ASCM threats.
- Naval surface forces use ESSM to provide a medium-range hard kill engagement capability against ASCM, surface, and low velocity air threats.
- Naval surface forces use CEC to provide accurate air and surface threat tracking data to SSDS.
- Naval surface forces will use AMDR as a primary sensor for simultaneous BMD and AD (to include self-defense) missions.

Major Contractors

- SSDS: Raytheon – San Diego, California
- RAM and ESSM: Raytheon – Tucson, Arizona
- CEC: Raytheon – St. Petersburg, Florida

Activity

- DOT&E issued a classified report to Congress on the ship self-defense mission area in November 2012. The report covers ship self-defense related operational testing conducted from February 2008 through December 2011 aboard USS *Ronald Reagan* (CVN-76), USS *Carl Vinson* (CVN-70), and the Self-Defense Test Ship (SDTS).
- The Navy's Commander, Operational Test and Evaluation Force (COTF) completed FOT&E testing of ESSM, RAM, CEC, and SSDS on the SDTS in December 2011. Testing was conducted in accordance with a DOT&E-approved test plan.
- COTF continued planning for operational testing of the ship self defense mission area during IOT&E of the RAM Block 2 and FOT&E of the SSDS Mk 2 Mod 4 and ESSM on the SDTS. The Navy plans to continue testing in November 2012.
- COTF continued planning for IOT&E testing of the LHA-6 class ship self-defense combat system on the SDTS. The Navy plans to commence IOT&E testing in November 2012.

Assessment

- The November 2012 DOT&E ship self-defense mission area report includes the following assessments:
  - The CVN-68 ship class combat systems continue to have difficulty defeating certain ASCM raid types. In particular, the legacy combat system sensor elements have limited capability against the threat surrogates used in those raid types.
  - The CVN-68 ship class combat system continues to have several problems that hinder it from successfully completing the ship self-defense mission. Specific problems include deficiencies in weapon employment timelines, sensor coverage, system track management, and NATO ESSM performance, as well as deficiencies with the recommended engagement tactics for use against multiple ASCM threat classes.
- The test infrastructure is inadequate to support self-defense testing on the next flight of destroyers. There is no unmanned, at-sea test capability to safely demonstrate a self-defense capability for Aegis destroyers against anti-ship missile threats. The test capability must be in place by 2020 to support DDG-51 Flight III Destroyer Combat System, ESSM Block 2, and AMDR integration self-defense operational testing.
- The classified November 2012 DOT&E report to Congress contains further ship self-defense mission area assessments.

Recommendations

- Status of Previous Recommendations. The Navy has satisfactorily completed the majority of previous recommendations. The Navy has not resolved the following previous recommendations:

1. Optimize SSDS Mk 2 weapon employment timelines to maximize weapon probability of kill.
2. Acquire range-safe supersonic sea-skimming ASCM surrogate targets for ESSM FOT&E with the Aegis Combat System.
3. Ensure availability of a credible open-loop seeker subsonic ASCM surrogate target for ship self-defense combat system operational tests.
4. Correct the identified SSDS Mk 2 software reliability deficiencies.
5. Correct the identified SSDS Mk 2 training deficiencies.
6. Develop and field deferred SSDS Mk 2 interfaces to the Global Command and Control System–Maritime and the TPX-42A(V) command and control systems.
7. Continue to implement the Program Executive Office for Integrated Warfare Systems' plan for more robust, end-to-end systems engineering and associated developmental/operational testing of ship self-defense combat systems.
8. Provide a capability to launch a raid of four supersonic sea skimming targets at the Naval Air Warfare Center/Weapons Division, Point Mugu, California, test range to support Test and Evaluation Master Plan-approved Air Warfare/Ship Self-Defense Enterprise testing planned for FY16.
9. Improve the ability of legacy ship self-defense combat system sensor elements to detect threat surrogates used in specific ASCM raid types.
10. Ensure availability of adequate and credible target resources for ship self-defense and electronic warfare operational testing.
11. Take action on the classified recommendations contained in the March 2011 DOT&E report to Congress on the ship self-defense mission area.

- FY12 Recommendations. Based on the classified information contained in the November 2012 report to Congress, the Navy should:
  1. Improve the SSDS Mk 2 integration with the Mk 9 Track Illuminators to better support ESSM engagements, as well as preventing the Mk 9 Track Illuminators from contributing to the composite track during certain threat raid types.
  2. Develop combat system improvements to increase the likelihood that ESSM and RAM will home on their intended targets.
  3. Conduct additional operational testing on the CVN-68 class once the ship is equipped with additional self-defense weapons. This additional testing will determine whether the additional weapons are sufficient to meet the ship's self-defense requirements.
  4. Develop an unmanned, at-sea self-defense test capability that will allow safe demonstration of the self-defense mission of DDG-51 Flight III destroyers against anti-ship missile threats.
  5. Take action on the classified recommendations contained in the November 2012 DOT&E report to Congress on the ship self-defense mission area.

SSN 774 *Virginia* Class Submarine

Executive Summary

- The Navy conducted two *Virginia* class FOT&E events that began in FY11 and extended into FY12. The first test event examined the *Virginia* class submarine's ability to operate under-ice and to conduct Anti-Submarine Warfare (ASW) in the Arctic. The second test event examined the modernized *Virginia* class submarine's performance with the Navy's latest combat system and sonar suite.
- DOT&E issued a classified report on the modernized *Virginia* FOT&E in November 2012, and concluded that the modernization of the combat system and sonar suite did not change the performance of the *Virginia* class for the missions tested.
- The Navy completed an update to the Test and Evaluation Master Plan (TEMP) and DOT&E approved the revision on July 24, 2012. The revision outlines plans to test deferred capabilities, electronic systems upgrades, and affordability changes included in the third increment of submarines (Block III).

System

- The *Virginia* class submarine is the replacement for the aging fleet of *Los Angeles* class submarines. The *Virginia* class:
  - Is capable of targeting, controlling, and launching Mk 48 Advanced Capability torpedoes, Tomahawk cruise missiles, and future mines
  - Has mission capability similar to the *Seawolf* submarine class with improvements to the electronic support suite, sonar, and combat control systems
  - Has a new-design propulsion plant incorporating components from previous submarine classes
  - Uses a modular design and significant commercial off-the-shelf computer technologies and hardware intended to allow for rapid and cost-effective technology refresh cycles
- The Navy is procuring and upgrading *Virginia* class submarines incrementally in a series of blocks.
  - Block I (hulls 1-4) and Block II (hulls 5-10) ships incorporated the initial design of the *Virginia* class.
  - Block III (hulls 11-18) ships will include the following affordability enhancements:
    - A Large Aperture Bow array will replace the spherical array in the front of the ship.
    - Two *Virginia* payload tubes will replace the 12 vertical launch tubes. Each payload tube is capable of storing and launching six Tomahawk land attack missiles used in strike warfare.
  - The Navy has not finalized the design for Block IV and beyond ships.

Mission

The Operational Commander will employ the *Virginia* class submarine to conduct open ocean and littoral covert operations in support of the following submarine mission areas:

- Strike Warfare (STW)
- Anti-Submarine Warfare (ASW)
- Intelligence, Surveillance, and Reconnaissance (ISR); Indications and Warnings (I&W); and Electronic Warfare (EW)
- Anti-Surface Ship Warfare (ASUW)
- Naval Special Warfare (NSW)
- Mine Warfare (MIW)
- Battle Group Operations (BGO)

Major Contractors

- General Dynamics Electric Boat – Groton, Connecticut
- Huntington Ingalls Industries, Newport News Shipbuilding – Newport News, Virginia

Activity

- In accordance with DOT&E-approved test plans, two *Virginia* class submarine FOT&E events started in FY11 and extended into FY12 due to data processing, data analysis, and reporting delays.
  - The Navy conducted the first FOT&E period in conjunction with a bi-annual Ice Exercise (ICEX-11). This event allowed testers to examine the *Virginia* class submarine's ability to transit to and operate under-ice and

in the Arctic. This test period also assessed the *Virginia* class's ASW mission performance against a modern threat SSN surrogate under-ice in the Arctic. As part of the transit to northern latitudes, testers examined the *Virginia* class' susceptibility to fixed passive sonar arrays. DOT&E plans to issue a report on this testing in 2QFY13.
  - The second FOT&E period was a series of test events to examine the mission performance changes as a result of the modernization of the *Virginia* class submarines' sonar and combat control system. These tests were combined with the operational evaluations of the latest variants of the Acoustic Rapid Commercial Off-the-Shelf Insertion (A-RCI) Sonar System, the AN/BYG-1 Combat Control System, and the Mk 48 Advanced Capability torpedo. DOT&E issued a combined operational test report on this testing in November 2012.
- The *Virginia* TEMP also required FOT&E in order to complete testing of the Naval Special Warfare mission support capabilities for the Dry Deck Shelter (DDS) and for a diver emergency recompression capability in the *Virginia* class submarine's Lock-Out Trunk (LOT). The Navy completed LOT and DDS system design changes and began test planning for the LOT diver oxygen recompression system certification and for operations with a DDS in FY12. The Navy plans to complete these test events in early FY13.
- DOT&E approved Revision G to the TEMP on July 24, 2012. The revision outlines plans to test the mission performance of the *Virginia* class affordability changes (new bow array and vertical payload tubes) with the electronic systems upgrades planned for the third increment submarines (Block III) and to complete the testing of deferred mission capabilities.
- Because Navy security rules prevent collection of useful operational test data from *Virginia* when conducting exercises with foreign ASW capable platforms, the Navy finished IOT&E and recent FOT&E without testing the *Virginia* class submarine against one of its primary threats, the foreign diesel electric submarine (SSK). The Navy investigated alternative test strategies as part of the TEMP update process. The approved strategy asserts that the primary data for assessing this capability will come from three sources: related sonar system testing on *Los Angeles* class submarines, the use of an onboard training system that injects simulated acoustic targets into the combat system, and the possibility for future testing against real allied-nations' SSKs when security rules are relaxed.
- The Block III design will require shock testing of the Common Weapons Launcher and the *Virginia* Payload Tube (VPT) hatch. The Navy plans to complete VPT hatch shock qualification testing in April 2013 to support the first Block III delivery in August 2014.
- The Navy is performing verification and validation of the Transient Shock Analysis (TSA) modeling method used for the design of *Virginia* class Block III items. The Navy plans to accredit the TSA modeling method in March 2013.
- The Navy plans to update the Vulnerability Assessment Report to include the Block III modifications in July 2014.

Assessment
- The Navy achieved test efficiencies by combining the operational testing of several programs into a series of test events. Since submarine platform and mission systems testing are interdependent, the consolidation of the *Virginia* class testing with A-RCI sonar, acoustic arrays, Mk 48 torpedoes, and the AN/BYG-1 testing increased test efficiency and enabled a more complete end-to-end evaluation of the *Virginia* class submarine's mission performance. This testing also provided insights into the effectiveness and suitability of each individual system and weapon the Navy uses on other classes of submarines.
- The FOT&E event in the Arctic was adequate; however, the transfer and analysis of the data were significantly delayed and the Navy did not retain some test data. DOT&E's assessment of *Virginia's* effectiveness in the Arctic environment and *Virginia's* susceptibility to low-frequency fixed passive sonar arrays will be contained in an early FY13 classified report.
- DOT&E's classified report on *Virginia's* modernization FOT&E, issued in November 2012, concluded the following:
  - *Virginia's* operational effectiveness is dependent on the mission conducted. The modernization of the sonar and fire control systems (A-RCI and AN/BYG-1) with the Advanced Processor Build 09 software did not change (improve or degrade) the performance of the *Virginia* class for the missions tested. DOT&E's assessment of mission effectiveness remains the same for ASW, ISR, High Contact Management, Situational Awareness, and Mine Avoidance. DOT&E's overall assessment of Information Assurance remains unchanged from IOT&E, although the new software represents an improvement in Information Assurance over previous systems.
  - Although *Virginia* was not effective for some of the missions tested, it remains an effective replacement for the *Los Angeles* class submarine, providing similar mission performance and improved covertness.
  - Testing to examine ASW-Attack and situational awareness in a high-surface-ship density environment was adequate for the system software tested, but not adequate for the software version fielded. After completion of operational testing, the Navy issued software changes intended to address the severe performance problems observed with the Wide Aperture Array. The Navy has not completed operational testing on the new software, which is fielded on deployed submarines. DOT&E assesses that the late fix of the array's deficiencies is a result of the Navy's schedule-driven development processes, which fields new increments without completing adequate developmental testing.
  - The Navy collected adequate data to assess the suitability of the sonar and fire control systems. Insufficient data were collected to reassess the suitability of *Virginia's* hull, mechanical, electrical, or electronic systems; however, these data were not expected to demonstrate significantly different reliability compared to what was

observed in IOT&E. Of note, the installation of the new Advanced Processor Build 09 of the A-RCI sonar system on *Virginia* class submarines will degrade the reliability of the sonar system on these submarines relative to what was demonstrated in the IOT&E.

Recommendations

- Status of Previous Recommendations. The Navy has made progress in addressing 22 of the 30 recommendations contained in the November 2009 classified BLRIP report and the October 2011 classified FOT&E report. Of the outstanding recommendations, the significant unclassified ones are:
  1. Test against an SSK threat surrogate in order to evaluate *Virginia's* capability, detectability, and survivability against modern diesel-electric submarines.
  2. Conduct FOT&E to examine *Virginia's* susceptibility to airborne ASW threats such as Maritime Patrol Aircraft and helicopters.
- FY12 Recommendations. The Navy should:
  1. Coordinate the *Virginia*, A-RCI, and AN/BYG-1 TEMPs and utilize Undersea Enterprise Capstone documents to facilitate testing efficiencies.
  2. Complete the verification, validation, and accreditation of the TSA method used for *Virginia* class Block III items.
  3. Repeat the FOT&E event to determine *Virginia's* susceptibility to low-frequency active sonar and *Virginia's* ability to conduct ASUW in a low-frequency active environment. This testing should include a *Los Angeles* class submarine operating in the same environment to enable comparison with the *Virginia* class.
  4. Address the 21 recommendations that are included in the November 2012 DOT&E-published FOT&E report on *Virginia's* modernization and the associated sonar and combat control systems. In particular, the Navy should re-evaluate operational effectiveness on a submarine with a repaired Wide Aperture Array.

Standard Missile-6 (SM-6)

Executive Summary

- The Navy completed the Phase 2 modeling and simulation in support of IOT&E in July 2012. Phase 2 was an extensive modeling and simulation effort that examined Standard Missile-6 (SM-6) battlespace with the legacy Aegis Weapon System but not the Navy Integrated Fire Control-Counter Air (NIFC-CA) or Aegis Baseline 9 capability.
- The Navy will not demonstrate achievement of all of the SM-6 Capability Production Document performance requirements until the fielding of the NIFC-CA From the Sea capability in FY14/15. The Navy plans to demonstrate NIFC-CA From the Sea SM-6 capability during FOT&E as documented in the SM-6 Test and Evaluation Master Plan.
- In IOT&E Phase 1 flight tests, SM-6 demonstrated significant new capabilities against maneuvering targets, low-altitude targets, and targets with electronic countermeasures, successfully completing 7 of 12 intercept attempts. Within the constraints of the legacy Aegis combat system, SM-6 also demonstrated the longest downrange engagement range for a Standard Missile to date. IOT&E Phase 2 modeling and simulation confirmed SM-6 performance demonstrated in flight test.
- To demonstrate corrective actions to suitability anomalies discovered during IOT&E, the Navy conducted a series of high-temperature wind tunnel and flight tests. The results of that testing demonstrated the corrective actions were effective; however, the unexpected discovery of insulation inter-layer delamination on three of five wind tunnel test articles questions the finality of the Navy's corrective actions. Additional testing is ongoing.
- An unresolved performance anomaly from flight-testing affects SM-6 effectiveness. The Phase 2 modeling and simulation testing confirmed this. The Navy is working to develop corrective actions for this performance deficiency; however, testing of these actions has not been scheduled.

System

- SM-6 is the latest evolution of the Standard Missile family of fleet air defense missiles that incorporates components from two existing Raytheon product lines: the SM-2 Block IV and the Advanced Medium-Range Air-to-Air Missile (AMRAAM).
- SM-6 is employed from cruisers and destroyers equipped with Aegis combat systems.

- The SM-6 seeker and terminal guidance electronics derive from technology developed in the AMRAAM program. SM-6 retains the legacy Standard Missile semi-active radar homing capability.
- SM-6 receives midcourse flight control from the Aegis combat system via ship's radar; terminal flight control is autonomous via the missile's active seeker or supported by the Aegis combat system via the ship's illuminator.

Mission

- The Joint Force Commander/Strike Group Commander will use SM-6 for fleet air defense against fixed-/rotary-winged targets and anti-ship missiles operating at altitudes ranging from very high to sea-skimming.
- The Joint Force Commander will use SM-6 as part of the NIFC-CA concept to provide extended-range, over-the-horizon capability against at-sea and overland threats.

Major Contractor

Raytheon Missile Systems – Tucson, Arizona

Activity

- The Navy completed Phase 2 of the IOT&E in July 2012 in accordance with the DOT&E-approved operational test plan. Phase 2 was an extensive modeling and simulation effort that examined legacy Aegis Weapon System SM-6 battlespace but not the NIFC-CA or Aegis Baseline 9 capability.

- The Navy conducted high-temperature wind tunnel tests to verify correction of the uplink/downlink antenna reliability deficiency. The Navy plans to continue this verification with the conduct of follow-on flight testing in FY13. The Navy conducted one SM-6 flight test in support of the Joint Land Attack Cruise Missile Defense Elevated Netted Sensor System (JLENS) integration testing. Data from this flight combined with the FY13 flight tests will provide some but not all of the data needed to verify the uplink/downlink antenna deficiencies have been corrected.

Assessment

- The Navy will not demonstrate all of the SM-6 Capability Production Document performance requirements until the fielding of the NIFC-CA From the Sea capability in FY14/15.
- In Phase 1 IOT&E, SM-6 demonstrated significant new capabilities against maneuvering targets, low-altitude targets, and targets with electronic countermeasures, successfully completing 7 of 12 intercept attempts. The current capabilities of the legacy Aegis SPY-1 B/D and associated combat system are unable to demonstrate the full operational capability of the SM-6. Within those constraints, SM-6 demonstrated the longest downrange engagement range for a Standard Missile to-date. Phase 2 modeling and simulation confirmed SM-6 performance demonstrated in flight test with the legacy Aegis combat system.
- As an excursion during the Phase 2 modeling and simulation activity, the Navy conducted a number of trials using third party sensors similar to the NIFC-CA capability. The trials indicated that the SM-6 battlespace will be significantly expanded once these capabilities are fielded.
- A performance deficiency discovered during IOT&E remains unresolved. The Phase 2 modeling and simulation trials confirmed this. The Navy is exploring corrective actions; however, implementation and testing of these corrective actions are not scheduled.
- The high-temperature wind tunnel tests of the uplink/downlink antenna reliability deficiency examined the antenna sealant material fixes and the insulation bonding manufacturing process improvements. The trials recorded no anomalies against these fixes; however, the unexpected discovery of insulation inter-layer delamination on three of five wind tunnel test articles questions the finality of the Navy's corrective actions. Coupled with the data collected on the JLENS integration flight test, the data are insufficient to assess corrective action efficacy on the overall uplink/downlink antenna reliability deficiency. DOT&E will continue to collect data on upcoming SM-6 FOT&E flight tests and will re-assess effectiveness and suitability when sufficient data are available.
- Based upon combined data from the IOT&E and developmental/operational flight tests, the SM-6 does not meet the flight reliability criteria established by USD(AT&L) for full-rate production. DOT&E will continue to collect reliability data during upcoming SM-6 FOT&E firings and will re-assess suitability at the conclusion of these tests.
- First seen in developmental testing, the Mk 54 Safe-Arm Device anomaly carried forward into IOT&E with additional occurrences. The Phase 2 modeling and simulation trials confirmed that the sensitivity of missile lethality is dependant on the fuze mode, target, and engagement conditions.

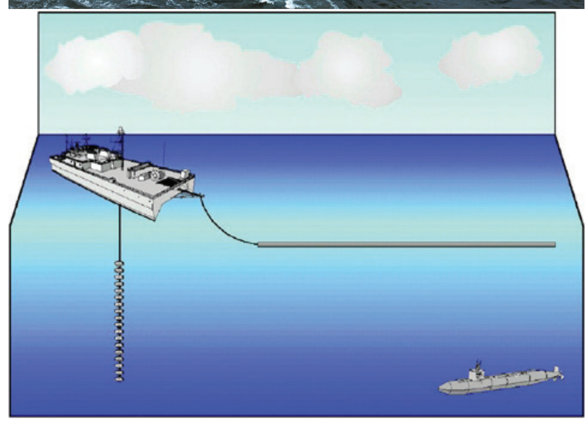
Recommendations

- Status of Previous Recommendations. The Navy is addressing the previous recommendations.
- FY12 Recommendation.
  1. Until reliability deficiencies are resolved, the Navy should consider issuing tactics that employ multiple missiles for certain targets.

Surveillance Towed Array Sensor System (SURTASS) and Compact Low Frequency Active (CLFA) System

Executive Summary

- The Navy has installed one engineering developmental model and two production Compact Low Frequency Active (CLFA) systems on three of the five Western Pacific-based tactical auxiliary general ocean surveillance (T-AGOS) ships. Installation of the CLFA system on remaining T-AGOS ships is not planned.
- The Navy's Commander, Operational Test and Evaluation Force (COTF) commenced IOT&E on the Surveillance Towed Array Sensor System (SURTASS)/CLFA during fleet exercise Valiant Shield 12 in September 2012. IOT&E will complete in FY13. The analysis of test data collected is still in progress. No preliminary evaluation is available.



System

- SURTASS/CLFA is a low frequency, passive and active, acoustic surveillance system installed on T-AGOS ships as a component of the Integrated Undersea Surveillance System (IUSS).
- SURTASS provides passive detection of quiet nuclear and diesel submarines and enables real-time reporting of surveillance information to Anti-Submarine Warfare (ASW) commanders.
- CLFA is a low frequency, active sonar system developed to provide an active detection capability of quiet submarines operating in environments that support active sonar propagation.
- The system consists of:
  - A T-AGOS host ship with array-handling equipment
  - A towed vertical string of active acoustic projectors
  - A towed horizontal twin line (TL-29A) acoustic array
  - An integrated common processor (ICP) for processing active and passive acoustic data
  - A communications segment to provide connectivity to shore-based IUSS processing facilities and to fleet ASW commanders

Mission

- Maritime Component Commanders employ T-AGOS ships equipped with SURTASS/CLFA systems to provide active and passive acoustic sensors for long-range ASW detection, classification, and tracking of submarines in support of theater naval operations.
- Maritime Component Commanders use SURTASS/CLFA to protect naval ships from threat submarines and to provide accurate targeting information to theater ASW forces to prosecute the threat submarines.

Major Contractors

- Overall Integrator: Maritime Surveillance Systems Program Office (PMS 485)
- ICP: Lockheed Martin – Manassas, Virginia
- CLFA Projectors: BAE – Nashua, New Hampshire
- CLFA Handling System: Naval Facilities Engineering Service Center (NAVFAC ESC) (Government Lab) – Port Hueneme, California
- High Frequency Marine Mammal Monitoring Sonar: Scientific Solutions Incorporated (SSI) – Nashua, New Hampshire
- TL-29A Towed Arrays: Lockheed Martin – Syracuse, New York

Activity

- After the August 2010 DOT&E Operational Assessment of SURTASS/CLFA installed on USNS *Able*, the Navy determined that additional system development was required to address system reliability, automated detection, and active tracking concerns before the system could proceed to IOT&E.
  - In January 2011, the Navy conducted at-sea test (AST) 11-2 to assess developmental changes to improve reliability.
  - In October 2011, the Navy conducted AST 11-4 to assess developmental changes to improve automated detection and active tracking performance.
  - In May 2012, the Navy conducted AST 12-1A as an advanced engineering analysis and system validation to inform a system certification decision.
  - On August 29, 2012, the Program Executive Office, Submarines certified the CLFA system ready to proceed to IOT&E.
- DOT&E approved the IOT&E test plan for SURTASS/CLFA on September 4, 2012, and agreed to use operationally realistic test and exercise data collected during a scheduled fleet exercise, Valiant Shield 12, which commenced on September 10, 2012, in the Western Pacific, as well as a dedicated test phase not associated with Valiant Shield 12.
- In September 2012, COTF and DOT&E commenced IOT&E on the SURTASS/CLFA system installed on USNS *Effective* (T-AGOS-21). Testing focused on SURTASS/CLFA contribution to coordinated ASW against threat diesel and nuclear submarines and included both passive and active sonar from multiple air and sea platforms. IOT&E will complete in FY13.
- The Navy acquired and installed one engineering developmental model and two production CLFA systems on three of the five Western Pacific-based T-AGOS ships. Installation of the CLFA system on remaining T-AGOS ships is not planned.

Assessment

- The conduct of IOT&E during an operationally relevant fleet exercise, Valiant Shield 12, allowed data collection that will provide insight into the effectiveness of SURTASS/CLFA as a primary contributor to theater ASW. The data will allow assessment of the ASW commander's ability to utilize SURTASS/CLFA contact reports with other ASW assets to protect surface ships and prosecute threat submarines.
- Due to a limitation in submarine support availability, substantially less data were obtained to support evaluation of the long-range active detection capability against threat-representative submarines than was planned. Additional testing is required to allow an adequate assessment.
- The analysis of test data collected during the combined SURTASS/CLFA IOT&E and Valiant Shield 12 fleet exercise is still in progress. No preliminary evaluation is available. DOT&E expects to issue a formal test report in FY13 after completion of IOT&E. The Navy has executed testing completed thus far in accordance with the DOT&E-approved test plan.

Recommendations

- Status of Previous Recommendations. The Navy and Program Office are satisfactorily addressing previous recommendations. The Navy implemented the FY11 recommendation to conduct IOT&E during a fleet exercise. The Program Office continued system development consistent with FY11 recommendations. Correction of deficiencies identified in COTF's and DOT&E's operational assessment reports will be validated during IOT&E.
- FY12 Recommendation.
  1. The Navy should complete remaining IOT&E to include a follow-on test event that allows an adequate determination of long-range active detection capability against threat-representative submarines.

T-AKE *Lewis & Clark* Class of Auxiliary Dry Cargo Ships

Executive Summary

- The second FOT&E test series (OT-IIIB) for the T-AKE *Lewis & Clark* program specifically addressed the ship's Chemical, Biological, and Radiological (CBR) defenses; Information Assurance (IA); and mine susceptibility including magnetic silencing (degaussing).
- While the majority of deficiencies were verified as corrected, a major deficiency involving corrosion in the Countermeasure Water Wash Down (CMWWD) piping system still remains.

System

- T-AKE *Lewis & Clark* is a class of non-combatant ships operated by the Military Sealift Command (MSC) designed to carry dry cargo, ammunition, and fuel (in limited amounts) for naval combat forces at sea. There are 14 ships in the class; 11 ships are under contract for the Combat Logistics Force and 3 additional ships for the Maritime Prepositioning Force (Future).
- The T-AKE is:
  - Constructed to commercial standards (American Bureau of Shipping) with some additional features to increase its survivability in hostile environments such as the Advanced Degaussing System to reduce the ship's magnetic signature against mines, shock resistance in selected equipment, and increased damage control measures in firefighting and stability
  - Operated by civilian mariners from the MSC and a small Navy military detachment
  - Propelled with a single shaft and propeller; driven by electric motors powered by diesel generators

Mission

The Maritime Component Commander can employ the T-AKE *Lewis & Clark* class of ships to:

- Re-supply other ships while connected underway using Standard Tensioned Replenishment Alongside Method rigs and embarked helicopters
- Move cargo and ammunition between a port and a larger consolidating replenishment ship, which stays with the Carrier/Expeditionary Strike Group
- Be part of the hybrid combination of ships of the Maritime Prepositioning Force (Future)

Major Contractor

General Dynamics National Steel and Shipbuilding Company – San Diego, California

Activity

- The Navy conducted OT-IIIB February through May 2012 in accordance with the DOT&E-approved test plan. It focused on final resolution of IA and survivability vulnerabilities. The tests were intended to continue evaluation of T-AKE operational effectiveness and suitability, verify deficiencies identified in IOT&E and an earlier FOT&E were corrected, and complete deferred OT&E.
- The Navy installed a new intruder detection system on T-AKE 12 and integrated the navigation and engineering control system with the ship's network.
- The Navy's Commander, Operational Test and Evaluation Force's (COTF) Blue Team completed an Operational Information Assurance Vulnerability Evaluation on T-AKE 12 while in-port in February 2012. COTF's Red Team completed a penetration test while underway during April and May 2012.
- During the May at-sea period, COTF completed CBR and magnetic mine survivability tests. The Navy installed a new Improved Point Detection System-Lifecycle Replacement (IPDS-LR) on T-AKE 12, which was evaluated during the CBR test.
- The Surface Warfare Center Panama City Division conducted the Advanced Mine Simulation System test series during May 2012.

Assessment

- During the Operational Information Assurance Vulnerability Evaluation, COTF's Blue Team found a number of potential Category I vulnerabilities within the various components of T-AKE 12. During the penetration test, however, none of the exploits the Red Team ran against T-AKE 12 were able to penetrate the ship's premise (outer most) router. However, the Red Team did achieve unauthorized access to the ship's computing system during the penetration test, which ultimately allowed the team to escalate user privileges and gain system access.
- During the CBR test, the ship's crew was able to don the necessary personal and collective equipment to defend themselves against the effects of CBR attacks and hazards. The newly installed IPDS-LR functioned properly and watch officers were able to respond to audible and visual alarms on the bridge. Unlike U.S. Navy ships, however, on MSC ships the IPDS-LR does not automatically activate the ship's general or chemical alarm. The crew must manually activate this alarm, followed by a general announcement that there is a CBR emergency.
- The CMWWD system was adequate. However, COTF conducted an additional test on T-AKE 1 (5 years old) that revealed that the system was severely degraded due to corrosion of the mild carbon steel piping.
- The analysis of test data collected while T-AKE operated near the Advanced Mine Simulation System (AMISS) is ongoing and no preliminary evaluation is available. DOT&E expects to issue a formal test report in 2QFY13.

Recommendations

- Status of Previous Recommendations. The Navy satisfactorily addressed all previous recommendations.
- FY12 Recommendations. The Navy should:
  1. Resolve IA Category I vulnerabilities.
  2. Resolve the CMWWD system's corrosion problem.

Tomahawk Missile and Weapon System

Executive Summary

- As demonstrated during FY12 test flights, the Tomahawk Weapon System continues to meet Navy standards for reliability and performance.
- As assessed in the February 2012 FOT&E report to Congress, the Tomahawk Weapon System continues to be effective and suitable.
- DOT&E considers the planned Operational Test Launch program to be adequate for continued verification of system reliability and accuracy. DOT&E places high value on continuing flight data collection to evaluate end-to-end system performance and reliability for all deployed and deployable Tomahawk missile variants. However, in FY12, the Navy discontinued flight testing of the fielded Block III missiles, which are to remain in operational use until FY20.

System

- The Tomahawk Land Attack Missile is a long-range, land attack cruise missile designed for launch from submarines and surface ships.
- Production of Tomahawk Block II and III missiles is complete. There are four fielded variants: a Block II with a nuclear warhead (not deployed), a Block III with a unitary conventional warhead, a Block III with a conventional submunitions warhead, and a Block IV with a conventional unitary warhead.
- Block IV Tomahawk is in production as the follow-on to the Block III conventional unitary warhead variant. These missiles are produced at lower cost and provide added capability, including the ability to communicate with command and control and be redirected to an alternate target during flight.
- The Tomahawk Weapon System also includes the Tomahawk Command and Control System (TC2S) and the shipboard Tactical Tomahawk Weapon Control Systems (TTWCS). The TC2S and TTWCS provide for command and control, targeting, mission planning, distribution of Tomahawk tactical and strike data, and post-launch control of Block IV missiles.

Mission

The Joint Force Commander employs the Tomahawk Weapon System for long-range, precision strikes against land targets.

Major Contractor

- Missile element: Raytheon Missile Systems – Tucson, Arizona
- Weapon Control System element: Lockheed Martin – Valley Forge, Pennsylvania
- Command and Control element: QinetiQ North America LLC – San Jose, California, and Boeing Inc. – St. Louis, Missouri

Activity

- DOT&E submitted the FOT&E operational test report to Congress in February 2012.
- In accordance with the DOT&E-approved Test and Evaluation Master Plan and operational test plan, the Navy continued to conduct FOT&E Operational Test Launches to verify reliability and performance of fielded Block III and IV Tomahawk missiles, their associated weapon control systems, and the TC2S. The Navy conducted a total of eight Tomahawk missile test launches in FY12.
- In FY12, DOT&E conducted a comparative flight reliability analysis of over 200 operational Tomahawk firings conducted by the fleet during FY11 to the reliability demonstrated during all Operational Test Launches conducted to date.

Assessment

- As demonstrated during FY12 test flights, the Tomahawk Weapon System continues to meet Navy standards for reliability and performance. As reported to Congress in the FY12 FOT&E report, the Tomahawk Weapon System continues to be effective and suitable.
- DOT&E considers the current Operational Test Launch program for all Tomahawk missile variants to be adequate

for continued verification of system reliability and accuracy. However, while Block IV testing is funded through FY13, the Navy is not funding further Block III test launches. The Block III missiles are to remain in operational use until FY20. DOT&E places high value on continuing flight test data to evaluate end-to-end system performance and reliability for all deployed and deployable Tomahawk missile variants.
- The DOT&E analysis of FY11 operational Tomahawk firings concluded that Tomahawk fleet firing reliability is consistent with observed FOT&E Operational Test Launch results.

Recommendations
- Status of Previous Recommendations. The Navy has addressed all previous recommendations.
- FY12 Recommendation.
  1. The Navy should resource the FOT&E Operational Test Launch series to include testing of all fielded missile variants.

Vertical Take-Off and Landing Unmanned Aerial Vehicle (VTUAV)

Executive Summary
- The Navy stopped production of the MQ-8B air vehicle after procuring 23 MQ-8Bs. They have not conducted IOT&E on the MQ-8B air vehicles. The Navy is considering replacement of the Schweizer 333 (MQ-8B) airframe with the Bell 407 (MQ-8C). MQ-8C development is in response to a U.S. Special Operations Command Joint Universal Operational Needs Statement.
- The Test and Evaluation Master Plan (TEMP) approved in 2007 is outdated and does not contain a clear path to successful development, integration, and testing of the Vertical Take-Off and Landing Unmanned Aerial Vehicle (VTUAV).
- The Navy deployed MQ-8B Fire Scout systems aboard Navy frigates USS *Simpson* and USS *Klakring* during 2012. The USS *Simpson* supported forward presence and training operations off the west coast of Africa while the USS *Klakring* conducted operations off the Horn of Africa. The *Simpson* and *Klakring* deployments aboard Navy frigates demonstrated that the VTUAV has potential to provide the commander with valuable Intelligence, Surveillance, and Reconnaissance (ISR) once the program addresses shortcomings identified during developmental testing. Demonstrated component lifecycle reliability is well below program planning levels.
- Past and present MQ-8B deployments aboard frigates and operations in support of the ISR Task Force resulted in a critical shortage of spare parts.
- Operational deployments and developmental testing confirmed that system reliability, availability, communications relay, and documentation remain unsatisfactory.
- Moving from the MQ-8B to the MQ-8C airframe may or may not improve VTUAV reliability.

System
- The VTUAV is a helicopter-based tactical Unmanned Aerial System comprised of up to three Fire Scout air vehicles with payloads, a shipboard integrated Ground Control Station with associated Tactical Common Data Link (TCDL), and the Unmanned Aerial Vehicle Common Automatic Recovery System (UCARS).

- The Navy intends the VTUAV with the MQ-8B to have the following capabilities:
  - Combat radius – 110 nautical miles
  - Endurance at combat radius – 3 hours on station
  - Target Identification – Small fast attack boats at 6 kilometer range
  - Initial payload consists of the AN/AAQ-22D Bright Star II electro-optical and infrared imaging system with laser designator
- The Navy is considering replacement of the Schweizer 333 (MQ-8B) airframe with the Bell 407 (MQ-8C).

Mission
Aviation detachments equipped with VTUAVs perform reconnaissance, surveillance, target acquisition, and communications relay missions in support of littoral Anti Submarine Warfare, Anti-Surface Warfare, and Mine Warfare operations. System deployments during 2012 provided reconnaissance and surveillance to units conducting combat operations ashore.

Major Contractor
Northrop Grumman-Ryan Aeronautical – San Diego, California

Activity
- The Navy has stopped production of the MQ-8B air vehicle after procuring 23 MQ-8Bs. Instead, the Navy has focused on development of the MQ-8C air vehicle (also known as the “Endurance Upgrade”) as a Rapid Deployment Capability. The Navy is considering replacement of the Schweizer 333 (MQ-8B) airframe with the Bell 407 (MQ-8C).
- MQ-8C development is in response to a U.S. Special Operations Command Joint Universal Operational Needs

Statement. The Program Office issued a sole source contract to Northrop Grumman for MQ-8C development.
- Northrop Grumman is conducting MQ-8C risk reduction flight testing using internal research and development funds.
- The Navy is considering procurement of 31 MQ-8C air vehicles (28 production air vehicles plus 3 research, development, and engineering air vehicles).
- The Navy has not conducted IOT&E on the 23 MQ-8B air vehicles already procured.
- The Navy is working on the integration of weapons and a search radar capability to the MQ-8B air vehicle in response to a Navy Urgent Operational Need.
- The Navy deployed MQ-8B Fire Scout systems aboard Navy frigates USS *Simpson* and USS *Klakring* during 2012. The USS *Simpson* supported forward presence and training operations off the west coast of Africa while the USS *Klakring* conducted operations off the Horn of Africa. The Navy's Commander, Operational Test and Evaluation Force published a Quick Reaction Assessment in September 2012.
- One Fire Scout system continues to support ISR Task Force operations in Afghanistan.
- The Navy lost two MQ-8B aircraft in April 2012. Operators aboard USS *Simpson* intentionally ditched one air vehicle after encountering problems with the recovery system. The Navy recovered this air vehicle. The second air vehicle was destroyed after crashing while operating in support of the ISR Task Force in Afghanistan.
- In May 2012, Naval Air Systems Command published an Interim Summary Report addressing the status of MQ-8B developmental testing.
- The Navy plans to update the TEMP by April 2013; this update is expected to expand the scope of IOT&E.

Assessment

- The TEMP approved in 2007 is outdated and does not contain a clear path to successful completion of IOT&E. The TEMP does not clearly define the objectives of near-term testing, nor does it prioritize future upgrades such as search radar and weapons integration.
- Developmental testing during 2012 verified the correction of several deficiencies that adversely affected system performance. Software updates corrected the target location error and payload automatic caging deficiencies. The software now allows skilled operators to conduct dual air vehicle operations.
- The *Simpson* and *Klakring* deployments demonstrated that the VTUAV has the potential to provide the commander with valuable ISR once the program addresses shortcomings identified during developmental testing.
- Data collected during operational deployments and developmental testing show that the VTUAV system has performed to a satisfactory level in the areas of air vehicle operations, maintainability, compatibility, interoperability, human factors, and safety.
- Demonstrated component lifecycle reliability is well below program planning levels. This resulted in unacceptable values for Availability, Mean Flight Hours Between Operational Mission Failures, and Mean Flight Hours Between Unscheduled Maintenance Actions, preventing the program from entering into IOT&E. This poor reliability adversely affects performance of the forward-deployed systems and increases the workload of the aviation detachments.
- The Navy based Fire Scout spare parts budgeting on design reliability and operating tempo in support of the Littoral Combat Ship. Past and present deployments aboard frigates and operations in support of the ISR Task Force combined with significantly lower lifecycle reliability have caused a critical shortage of spare parts.
- Data collected during operational deployments and developmental testing confirmed that system performance in the areas of reliability, availability, communications relay, and documentation remain unsatisfactory.
- The Navy has yet to assess several critical areas related to VTUAV performance. These include tactics, logistics supportability, training, and manning. Each of these areas, in and of themselves, could render the system not effective or not suitable during IOT&E.
- Moving from the MQ-8B to the MQ-8C airframe may or may not improve VTUAV reliability. While the Navy will not see some failure modes specific to the MQ-8B on the MQ-8C, the MQ-8C includes systems not found on the MQ-8B.

Recommendations

- Status of Previous Recommendations. The Navy has made satisfactory progress on three of the four FY11 recommendations. It has developed overland ISR standard operating procedures and an operator training syllabus for aviation detachments operating VTUAV. The Navy has also established an office to review and coordinate all Navy UAS development and fielding, which addresses the recommendation to conduct an end-to-end review of its command and control network to facilitate the dissemination of near-real-time video. Given the delay in IOT&E, the one remaining recommendation to expand the scope of IOT&E will be addressed as the Navy updates the TEMP.
- FY12 Recommendations. The Navy should:
  1. Conduct in-depth shipboard testing to fully characterize TCDL performance to include air vehicle orientation in relation to the ship and ship orientation in relation to the air vehicle.
  2. Use available data to conduct a formal assessment of VTUAV tactics, logistics supportability, training, and manning to identify areas of risk to successful IOT&E.
  3. Conduct a failure mode analysis between the MQ-8C and the MQ-8B to determine which failure modes are common, which failures modes do not transfer from the MQ-8B to the MQ-8C, and which failure modes are unique to the MQ-8C.

Air Force Programs

Air Force Programs

AIM-120 Advanced Medium-Range Air-to-Air Missile (AMRAAM)

Executive Summary

- In 2009, key stakeholders, including the Program Office and DOT&E, suspended progression of the AIM-120D to operational testing due to four performance and reliability deficiencies. Raytheon addressed the four deficiencies, and DOT&E signed the revised AIM-120D Test and Evaluation Master Plan (TEMP) and separate, detailed operational test plan on May 25, 2012.
- The Air Force completed an Operational Test Readiness Review on May 31, 2012, and certified the AIM-120D Advanced Medium-Range Air-to-Air Missile (AMRAAM) to begin operational testing in June 2012. AIM-120D operational testing will consist of seven live missile shots and multiple captive-carry events. The Services are projected to complete operational testing in FY14.
- During operational testing to date, the Air Force has accomplished three AIM-120D shots, the first of which was unsuccessful. The unsuccessful shot was due to a reliability failure of a legacy Shortened Control Actuation System. The Air Force has re-executed this shot and is awaiting data analysis to determine its success.
- The AMRAAM Electronic Protection Improvement Program (EPIP) is a software upgrade to AIM-120C3-C7 variants currently in integrated testing, under the separate EPIP TEMP that DOT&E approved in April 2012.

System

- The AIM-120 AMRAAM is an all-weather, radar-guided air to-air missile with capability in both the beyond-visual-range and within-visual-range arenas. A single launch aircraft can engage multiple targets with multiple missiles simultaneously when using AMRAAM.
- The AMRAAM program develops and incorporates phased upgrades periodically. AMRAAM EPIP is a software upgrade to AIM-120C3-C7.
- The latest version, the AIM-120C7, incorporated an upgraded antenna, receiver, signal processor, and new software algorithms to counter new threats. The use of smaller system components created room for future growth.
- The AIM-120D is currently in development, and the Air Force intends for it to deliver performance improvements beyond the AIM-120C7 through the use of an internal GPS, an enhanced datalink, and new software.

Mission

- The Air Force and Navy, as well as several foreign military forces, use various versions of the AIM-120 AMRAAM to shoot down enemy aircraft.
- All U.S. fighter aircraft use the AMRAAM as the primary beyond-visual-range air-to-air weapon.

Major Contractor

- Raytheon Missile Systems – Tucson, Arizona
- Rocket Motor Subcontractors:
  - Alliant Techsystems (ATK) – Arlington, Virginia
  - Nammo – Raufoss, Norway

Activity

AIM-120D

- Production of the AIM-120D began in 2006, and developmental testing, which included three integrated developmental/operational test missile shots, began in 2007.
- In 2009, key stakeholders, including the Program Office and DOT&E, suspended progression of the AIM-120D to operational testing due to four performance and reliability deficiencies, including missile lockup, built-in test failures, aircraft integration problems, and poor GPS satellite acquisition.
- The Air Force accomplished the final developmental/operational test shot in August 2011. Raytheon addressed the four deficiencies, and DOT&E signed the TEMP and separate operational test plan on May 25, 2012. The Air Force conducted an Operational Test Readiness Review in May 2012, and certified the program to begin operational testing in June 2012. Testing

is progressing in accordance with the DOT&E-approved TEMP and test plan.
- AIM-120D operational testing will consist of seven live missile shots and multiple captive-carry events. The Services are projected to complete operational testing in FY14.

AMRAAM EPIP
- DOT&E approved the AMRAAM EPIP TEMP on April 13, 2012, after which integrated testing began.

Lot Acceptance Test/Rocket Motors
- Beginning in December 2011, propellant hot spots, burn through, and failures at low temperatures (-65 degrees Fahrenheit) caused unpredictable Lot Acceptance Test (LAT) failures. ATK, the subcontractor who produces the rocket motors, continues to investigate these failures.
- The Program Office, Raytheon, and AMRAAM safety communities coordinated to certify Nammo to become an approved alternative rocket motor supplier.
- The Program Office has suspended performance-based payments until resolution of the shortage of rocket motors due to unacceptable LAT performance.

Assessment
- The Air Force originally planned for AIM-120D to begin operational testing in 2008; it is now approximately four years behind schedule.
- The Air Force adequately addressed fixes to the four performance and reliability deficiencies that precluded AIM-120D from proceeding to operational testing:
  - Raytheon fixed the built-in test false alarm with a software modification.
  - Raytheon fixed the GPS failure problem with a GPS filter, which was verified with multiple laboratory events and a successful live missile shot.
  - The Air Force and Navy requirements sponsors clarified software requirements, and subsequent software changes reduced the frequency of missile lockups.
  - Software changes mitigated some aircraft integration problems, but more problems will need resolution in a System Improvement Program following operational testing.
- Since the start of operational testing, the Air Force has executed three live missile shots. The first was a reliability failure most likely due to a grounding wire common to all AMRAAM variants going back to the AIM-120C5. The second live missile shot was the first AIM-120D launch from an F-22 and resulted in a direct hit on the drone. The third was a re-execution of the first live missile shot and the Air Force is awaiting data analysis to determine its success. Additionally, captive-carry performance has been nominal and the Air Force has yet to quantify system reliability.
- The shortage in rocket motors due to unacceptable LAT performance should not significantly affect AIM-120D testing, but it has created a backlog in production. After Insensitive Munitions certification in October 2012, Nammo will be the only AIM-120D and AIM-120C7 rocket motor producer for the foreseeable future. The government and Raytheon are still reviewing a path forward for ATK production.

Recommendations
- Status of Previous Recommendations. The FY07 recommendation for the Program Office to seek changes to the Air Force's full-scale and sub-scale target programs to ensure proper target presentation, target reliability, and availability remains valid. The Air Force has adequately addressed all other previous recommendations.
- FY12 Recommendations.
  1. The Air Force should complete a System Improvement Program within one year of the completion of operational testing to address any remaining aircraft integration problems, as well as any problems discovered during operational testing.
  2. The Program Office should continue root cause analysis of rocket motor LAT failures and keep the Air Force, Navy, and OSD updated on potential impacts to cost, schedule, and performance.

Air Operations Center – Weapon System (AOC-WS)

Executive Summary

- The Air Operations Center – Weapon System (AOC-WS) 10.1 is a system-of-systems that contains numerous third-party software applications, including the Global Command and Control System – Joint (GCCS-J), Theater Battle Management Core Systems – Force Level (TBMCS-FL), Master Air Attack Plan Toolkit (MAAPTK), and Joint Automated Deep Operations Coordination System (JADOCS).
- The Air Force tests AOC-WS 10.1 software upgrades during Recurring Events (REs) and refers to each software upgrade by the event during which it was tested. For example, AOC-WS 10.1 RE11 is the software upgrade that was tested during RE11.
- The Air Force conducted operational testing of RE11 in March 2012 using older servers due to a short timeline to integrate newer servers for test.
- The 605th Test and Evaluation Squadron (TES) conducted a regression test in May 2012 on newer, more powerful servers. This test included additional software fixes to GCCS-J provided by the Defense Information Systems Agency (DISA).
- From July through September 2012, the Air Force conducted a third phase of RE11 operational testing at the 613th AOC, Hickam AFB, Hawaii.
- Using RE11, operators can successfully execute all critical missions and produce threshold or larger-sized target lists and Air Tasking Orders on schedule. The Common Operational Picture exceeded the AOC requirement for updating and displaying the threshold number of tracks in near real-time.
- RE11 demonstrated interoperability with other mission-critical systems. Operational testing showed that RE11 addresses the significant legacy RE10 and GCCS-J deficiencies identified from previous testing. RE11 provides a significant improvement to AOCs both in internal functionality, as well as in interoperability with Combatant Commands.
- The 605th TES is still evaluating RE11's operational suitability; however, data collected to date indicate the need for some improvement. RE11 requires significant manpower to maintain the security posture of the system. Each operational AOC has site-unique requirements that each unit must incorporate into RE11. The AOC-WS Help Desk is working to adapt their enabling concept to include the enhanced capabilities in RE11.
- Users find training acceptable, and the overall system availability is acceptable. Information Assurance risk is acceptable, and the system has obtained an Authority to Operate.

System

- The AOC-WS is the senior command and control element of the U.S. Air Force's Theater Air Control System and provides operational-level command and control of air, space, and cyberspace operations, as well as joint and combined air, space, and cyberspace operations. Capabilities include command and control of joint theater air and missile defense; time-sensitive targeting; and intelligence, surveillance, and reconnaissance management.
- The AOC-WS 10.1 (AN/USQ-163 Falconer) is a system-of-systems that contains numerous third-party-developed software applications and commercial off-the-shelf products. Each third-party system integrated into the AOC-WS provides its own programmatic documentation.
- The AOC-WS consists of:
  - Commercial off-the-shelf hardware
  - Separate third-party software applications (GCCS-J, TBMCS-FL, MAAPTK, and JADOCS), from which the AOC-WS draws its capabilities
  - Additional third-party systems that accept, process, correlate, and fuse command and control data from multiple sources and share them through multiple communications systems
- AOC-WS 10.1 operates on several different local area networks (LANs), including Secret Internet Protocol Router Network, Joint Worldwide Intelligence Communications System, and a coalition LAN, when required. The LANs connect the core operating system and primary applications to joint and coalition partners supporting the applicable area of operation. Users can assess web-based applications through the Defense Information Systems Network.
- The Air Force tests AOC-WS 10.1 software upgrades during REs. The Air Force refers to each software upgrade by the event during which it was tested. For example, AOC-WS 10.1 RE11 is the software upgrade that was tested during RE11.
- The future AOC-WS 10.2 will be the first increment for modernization.

Mission
The Commander, Air Force Forces, or the Joint/Combined Forces Air Component Commander use the AOC-WS to exercise control of joint (or combined) air forces including planning, directing, and assessing air, space, and cyberspace operations to meet operational objectives and guidance.

Major Contractors
- AOC-WS 10.1 Production Center: Jacobs Technology Inc., Engineering and Technology Acquisition Support Services – Hampton, Virginia
- AOC-WS 10.2 Modernization: Northrop Grumman Corporation – Hampton, Virginia

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Activity
- The Air Force has developed an RE test cycle for major AOC-WS 10.1 upgrades, along with lower-level testing events to sustain interoperability and Information Assurance, and to provide low-risk upgrades to third-party systems as required. DOT&E approved an update to the program's Test and Evaluation Master Plan in December 2011, and approved an overarching operational test plan for all AOC-WS 10.1 testing in February 2012.
- The Air Force conducted developmental testing of RE11 in January 2012 and made several fixes to mission-critical problems. The Air Force conducted a subsequent regression test in February 2012.
- RE11 introduced GCCS-J Integrated Imagery and Intelligence as the intelligence and targeting capability provider for AOC-WS and upgraded TBMCS-FL with Maintenance Release 2 to migrate to current Modernized Integrated DataBase (MIDB) 2.1. Without the TBMCS-FL and GCCS-J upgrades, the AOC-WS is restricted to using a less-capable MIDB 2.0.
- Air Combat Command (ACC) conducted a risk analysis of the 11 open Category I test problem reports following the developmental and regression test. ACC determined the best course of action to meet current operational need was to proceed to operational testing and fielding of RE11.
- ACC developed a plan of action and milestones to address the 11 open Category I deficiencies at the time of operational test initiation. This decision was to be revisited if any additional Category I problems were discovered during operational test.
- The Air Force conducted operational testing of RE11 in March 2012. The AOC-WS Program Office had addressed 4 of the 11 open Category I problem reports by the start of the operational test. The GCCS-J portion of this testing was conducted on older servers; previous testing has shown that these servers have insufficient computing power. The newer, more powerful servers were not available in time to meet the initial integration and test schedule.
- The 605th Test and Evaluation Squadron conducted regression testing of RE11 in May 2012 using newer, more powerful servers to host the GCCS-J software. DISA had also provided several fixes to GCCS-J in the form of an Update 1 software release.
- The Air Force conducted a third phase of operational testing of RE11 at the 613th AOC, Hickam AFB, Hawaii, July through September 2012. This testing focused on the ability of the install team to correctly upgrade and configure the AOC from legacy RE10 to RE11, and perform backup and recovery actions on RE11.
- DISA provided additional fixes to GCCS-J to the Air Force for incorporation into the next upgrade (RE12), currently scheduled for developmental and operational testing in December 2012.
- The Air Force conducted all RE11 testing in accordance with the DOT&E-approved test plan.

Assessment
- The Air Force adequately tested RE11 through a combination of developmental and operational testing.
- RE11 can successfully execute all critical missions and produce threshold or larger-sized target lists and Air Tasking Orders on schedule. The Common Operational Picture was able to exceed the AOC requirement for updating and displaying the threshold number of tracks in near real-time.
- RE11 demonstrated interoperability with other mission-critical systems. Operational testing showed that RE11 could address the significant AOC-WS and GCCS-J deficiencies identified from previous testing.
- Users successfully demonstrated the ability to transfer Joint Forces Air Component Command responsibilities. Users encountered three Category I critical deficiencies with third-party software systems that are used within RE11, but these problems did not prevent mission accomplishment. ACC accepted these limitations while encouraging prompt resolution of these problems. RE11 provides a significant improvement to AOCs, in both internal functionality as well as their ability to interoperate with their respective Combatant Commands.
- The 605th TES is still evaluating RE11's operational suitability; however, data collected to date indicate the need for some improvement. RE11 requires significant manpower to maintain the security posture of the system on a recurring basis and the AOC-WS password change procedures are complex and inordinately lengthy. The GCCS-J backup and recovery, and server password change procedures for the newer servers are deficient. System administrators require extensive training in order to competently manage the system. Each operational AOC has site-unique requirements that must be incorporated into RE11. The AOC-WS Help Desk is working to adapt their enabling concept to include the enhanced capabilities in RE11. Users find training acceptable and the overall system availability meets requirements. Information Assurance risk

is acceptable, and the system has obtained an Authority to Operate.
- The key to successful testing and fielding of RE11 has been closer collaboration between the AOC-WS Program Office and DISA to ensure GCCS-J meets the operational needs of the AOCs. As a result of AOC-WS tester involvement in GCCS-J testing, the AOC-WS testers identified critical problems early for corrective action.
- The high-priority fixes DISA provided to GCCS-J in Update 1 improved data exchange between GCCS-J and RE11.

Recommendations
- Status of Previous Recommendations. The Air Force is adequately addressing previous recommendations. Two of the FY11 recommendations are long-term improvements that are currently being worked and still need continued effort.
  1. Coordinate with third-party programs to ensure that critical AOC-WS third-party systems (such as GCCS-J) have testable requirements that meet AOC-WS requirements. Requirements should be properly vetted within the appropriate user and program communities for schedule and funding priority.
  2. Ensure the AOC-WS users and test community continue to actively participate in GCCS-J developmental and operational testing and collaborate to develop a capability to adequately test GCCS-J to AOC-WS threshold stress levels.
- FY12 Recommendations.
  1. The Air Force should address suitability concerns with RE11, especially enabling system managers to more easily maintain the security posture of the RE11.
  2. Per the recommendation from DOT&E's Information Assurance/Interoperability assessment memorandum to the Director of Operations (J3), Joint Staff, the Joint Staff should establish or identify a systems integration group for command and control systems. These command and control systems will be responsible for providing comprehensive oversight/management of joint command and control systems and mission-critical interfaces, with particular emphasis on joint data fusion and operations centers, such as the AOC. Systems that should be addressed include, but are not limited to, GCCS-J, MIDB, TBMCS-FL, JADOCS, Joint Targeting Toolbox, and AOC-WS.

ALR-69A Radar Warning Receiver (RWR)

Executive Summary

- The Air Force Operational Test and Evaluation Center (AFOTEC) accomplished IOT&E from May 18 through July 16, 2012. The flight tests were flown at the Fallon Range Training Complex, Nevada, and the Multi-Spectral Test and Training Environment at Eglin AFB, Florida, resulting in a total threat exposure time of 12 hours. The system logged a total of 204 hours of operating time during IOT&E.
- DOT&E assessed the system as not operationally effective but operationally suitable. The system was not operationally effective because it did not consistently provide the aircrew timely and accurate threat information and the system demonstrated a random threat symbol splitting deficiency. Threat symbol splitting occurs when one threat signal received by the system produces multiple threat symbols at different azimuths on the cockpit display. This degrades the aircrew's situational awareness as to which displayed threats are "real" and where those real threats are located and inhibits the aircrew's ability to appropriately react to the threat(s) in a timely manner. The details of the DOT&E assessment are presented in DOT&E's classified IOT&E report, dated October 2012.
- Although the Air Force System Program Office (SPO) and Raytheon conducted hardware-in-the-loop (HWIL) tests to demonstrate the threat signal splitting deficiency has been resolved, DOT&E does not think HWIL testing by itself is adequate to verify the deficiency has been resolved and that the software update did not induce any other adverse system performance.

System

- The ALR-69A is a Radar Warning Receiver (RWR) that detects, identifies, and locates threat electronic signals.
- The Core ALR-69A RWR is designed to improve performance over the Air Force's primary RWR system, the ALR-69, by enhancing:
  - Detection range and time
  - Accuracy of threat identification
  - Location of threat emitter systems
  - Performance in a dense signal environment
  - Reliability and maintainability

1 - Legacy ALR-69 Components
2 - Primary ALR-69 Components
3 - Radar Receiver
4 - Countermeasure Signal Processor

- The system integrates with transport and fighter aircraft. The lead platform is the C-130H, with other platforms possibly to be added at a later date.
- Core ALR-69A RWR components include:
  - Radar receivers (previously the digital quadrant receivers)
  - Modular Countermeasures Signal Processor (previously the countermeasures computer)
  - Control indicator
  - Azimuth indicator

Mission

- Combatant Commanders will use ALR-69A to enhance the survivability of transport, fighter, and Special Operations aircraft on missions that penetrate hostile areas.
- Aircrews use the ALR-69A to provide indication of ground and airborne radar threats in order to support threat avoidance maneuvers and/or timely use of defensive countermeasures.

Major Contractor

Raytheon, Space and Airborne Systems – Goleta, California

Activity

- The Air Combat Command 413th Flight Test Squadron issued a Developmental Test and Evaluation (DT&E) report in February 2012 to the SPO at Warner Robins Air Force Base, Georgia. The report covered testing accomplished between February 2010 and May 2011. The SPO briefed DT&E results to the Milestone Decision Authority in November 2011.
- DOT&E approved the AFOTEC IOT&E Test Concept on February 12, 2012, and approved the IOT&E test plan

and revised Test and Evaluation Master Plan (TEMP) on February 16, 2012.

- AFOTEC began suitability flights in April 2012, and held IOT&E test crew training in early May 2012, with several suitability flight tests occurring shortly afterwards.
- AFOTEC began operational flight testing on May 18, 2012, at the Fallon Range Training Complex, Nevada. As a result of weather and competing range priorities, the system was only exposed to range threats for approximately 4 hours. In response, AFOTEC flew three additional missions on June 12, 13, and 15 at the Multi-Spectral Test and Training Environment at Eglin AFB, Florida. The combination resulted in a total threat exposure time of 12 hours. The system logged a total of 204 hours of operating time during IOT&E.
- AFOTEC conducted the final test of IOT&E on July 16, 2012. It was a ground-based test designed to evaluate the system's reprogramming capability.
- On August 1, 2012, the Air Force SPO and Raytheon conducted a HWIL test comparing the performance of the ALR-69A software that was used during IOT&E to updated software generated to correct a threat symbol splitting deficiency observed throughout IOT&E.
- AFOTEC did not execute testing in accordance with the DOT&E-approved test plan. AFOTEC deviated from the test plan in the following areas: AFOTEC pre-briefed aircrews about the type and location of threats, which reduced DOT&E's ability to determine the contribution the ALR-69A made to the aircrew's situational awareness; several missions lacked operational realism; and aircrew questionnaires did not incorporate inputs from DOT&E to improve the quality of the data generated from the questionnaires.

Assessment

- DOT&E assessed the ALR-69A system as not operationally effective but operationally suitable. The system was not operationally effective because it did not consistently provide the aircrew timely and accurate threat information and the system demonstrated a random threat symbol splitting deficiency. Threat symbol splitting occurs when one threat signal received by the system produces multiple threat symbols at different azimuths on the cockpit display. This degrades the aircrew's situational awareness as to which displayed threats are "real" and where those real threats are located and inhibits the aircrew's ability to appropriately react to the threat(s) in a timely manner. The details of the DOT&E assessment are presented in DOT&E's classified IOT&E report, dated October 2012.
- Although the SPO and Raytheon conducted HWIL tests to demonstrate the threat signal splitting deficiency has been resolved, HWIL testing by itself is not adequate to verify the deficiency has been resolved and that the software update did not induce any other adverse system performance.

Recommendations

- Status of Previous Recommendations. DOT&E last reported on this program in FY09. The Air Force has satisfactorily addressed previous recommendations.
- FY12 Recommendations. The Air Force should:
  1. Correct aircrew threat audio warnings so that the appropriate tone is associated with the correct status of the threat.
  2. Improve the timeliness and accuracy of threat information provided to the aircrew to improve the aircrew's situational awareness.
  3. Conduct flight testing to verify the system is operationally effective and that the software upgrade implemented by the SPO and Raytheon corrects the threat symbol splitting deficiency and did not degrade system performance in any other area.

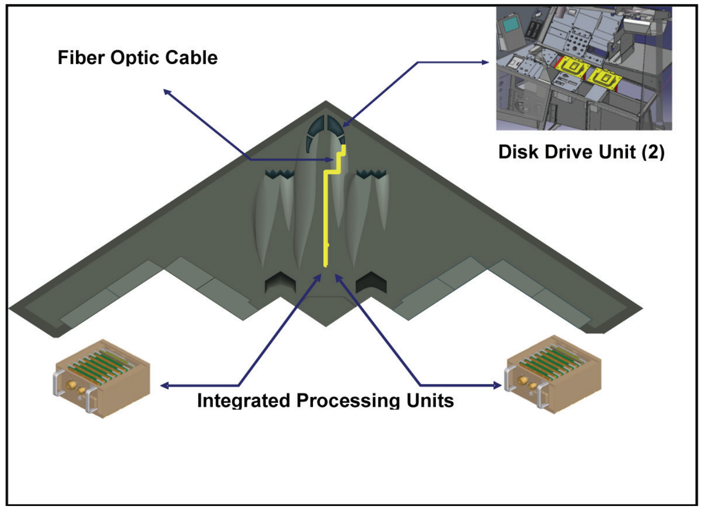
B-2 Extremely High Frequency (EHF) Satellite Communications (SATCOM) and Computer Upgrade Program

Executive Summary

- Developmental flight testing that began in September 2010 completed in April 2012.
- The Air Force Operational Test and Evaluation Center (AFOTEC) conducted IOT&E from June through August 2012 to assess the program's operational effectiveness, suitability, and mission capability. The IOT&E included 6 sorties and 56 hours of dedicated flight testing including navigation, long duration missions, and both conventional and nuclear weapons delivery events. IOT&E further assessed effectiveness and suitability data across 283 hours of developmental/integrated flight test missions conducted during formal developmental testing.
- IOT&E results indicate the system is operationally effective. However, the limited flight test hours accumulated preclude DOT&E from making a definitive assessment of the system's ability to meet the legacy system demonstrated Mean Time Between Critical Failure (MTBCF) of 671 hours. Therefore, continued monitoring of installed system performance in operational aircraft is necessary to confirm reliability.
- The Air Force plans to conduct the Full-Rate Production Decision in December 2012.

System

- The B-2 is a multi-role, low-observable bomber, capable of delivering conventional and nuclear munitions. It has four turbofan engines and twin side-by-side weapons bays.
- B-2 system avionics include a multi-mode radar, GPS-aided navigation, and a Defensive Management System for radar warning functions.
- The B-2 Extremely High Frequency (EHF) Satellite Communications (SATCOM) and Computer Upgrade program is designed to deliver capability across distinct increments. Increment 1 upgrades the core flight management processing capability of the B-2 and lays the foundation for subsequent avionics upgrades. Increment 1 replaces the existing aircraft flight management computers with two new Integrated Processing Units and two new Data Drive Units to increase data storage. Increment 1 also re-hosts the aircraft Flight Management Operational Flight Program from its legacy flight management software programming language, JOVIAL, to C.



- Follow-on B-2 EHF SATCOM Increments will remove the legacy B-2 MILSTAR AN/ASC-36 Ultra High Frequency (UHF)/Air Force SATCOM System, and add the Family of Advanced Beyond Line-of-Sight Terminals and a low observable antenna to support EHF and Advanced EHF communications connectivity. The final Increment is planned to be software-centric and provide full software integration of the B-2 EHF SATCOM upgrade, including Global Information Grid connectivity.

Mission

- Combatant Commanders use the B-2 aircraft to attack global targets during the day or at night, in all weather, in highly defended threat areas at the strategic, operational, and tactical levels of warfare.
- Commanders use the B-2 to engage high-value, heavily defended target sets including: command and control facilities, airfields, industrial complexes, logistical and air defense systems, lines of communication, and battlefield forces and equipment.

Major Contractor

Northrop Grumman – Falls Church, Virginia

Activity

- The Air Force conducted B-2 EHF SATCOM Increment 1 testing in accordance with the DOT&E-approved Test and Evaluation Master Plan and IOT&E plan.
- Developmental flight testing that began in September 2010 completed in April 2012. AFOTEC conducted IOT&E from

June through August 2012 to assess the program's operational effectiveness, suitability, and mission capability. IOT&E included 6 sorties and 56 hours of dedicated flight testing including navigation, long-duration missions, and both conventional and nuclear weapons delivery events. IOT&E further assessed effectiveness and suitability data across 283 hours of developmental/integrated flight test missions conducted during formal developmental testing.
- The Air Force plans to conduct the Full-Rate Production Decision in December 2012.

Assessment
- Results from the IOT&E indicate B-2 met legacy SATCOM, nuclear and conventional weapons accuracy, and navigational system accuracy.
- Accumulated system flight test hours were sufficient to evaluate overall system maintainability consistent with the B-2 Global Strike Concept of Operations. However, the limited flight test hours accumulated preclude DOT&E from making a definitive assessment of the system's ability to meet the legacy system demonstrated operational MTBCF of 671 hours. Therefore, continued monitoring of installed system performance in operational aircraft is necessary to confirm reliability.
- Operational availability of 96.6 percent did not meet the legacy system performance, but the difference is not operationally significant.

Recommendations
- Status of Previous Recommendations. The Air Force has addressed all previous recommendations.
- FY12 Recommendation.
  1. The Air Force should monitor fielded performance to ensure that system MTBCF and operational availability meet user requirements within a narrower set of confidence bounds as fleet flying hours accumulate.

Battle Control System – Fixed (BCS-F)

Executive Summary

- Air Combat Command completed a Force Development Evaluation (FDE) on the Battle Control System – Fixed (BCS-F) Increment 3, Release 3.1.3 (R3.1.3) and fielded it at all U.S. air defense sites in December 2011.
- Results from testing found R3.1.3 supports North American Aerospace Defense Command (NORAD) air defense operations with shortfalls in training and technical system documentation, system security management, and system combat identification operations. R3.1.3 testing also revealed significant deficiencies in Information Assurance (IA).
- The Air Force completed IOT&E and FDE on the BCS-F R3.2 at all U.S. air defense sites in September 2012. R3.2 presented some IA improvements and achieved an interim Authority to Operate.

System

- The BCS-F is a tactical air battle management command and control system that provides the two continental U.S. NORAD air defense sectors, as well as the Hawaii and Alaska Regional Air Operation Centers, with commercial off-the-shelf hardware using an open-architecture software configuration. The system operates within the NORAD air defense architecture and is employed by the U.S. and Canada.
- The R3.2 upgrade includes the following system enhancements:
  - Improved tactical datalinks with additional Link 16 and Link 11 message types that enable the operators to better digitally control fighters, send amplifying intelligence information, and create a more comprehensive air picture
  - Air Tasking Order (ATO) and Airspace Control Order (ACO) integration with theater battle management core system data sources that enables the operators to view the most current ATO/ACO and correlate the information with military aircraft
  - Adaptation data modification tools to enable system administrators easier field changes to system adaptation files and to perform error checks with greater fidelity
  - System control manager interface improvements that enable the system administrator improved system performance monitoring and diagnostics
  - Global Area Reference System coordinate conversion tool that facilitates NORAD interface with global search and rescue efforts ensuring a common set of coordinates
  - Remote Gateway Manager control through the virtual network computing interface that provides the operators a complete picture of the available datalinks and the flexibility to access link information from an operator workstation
  - Auxiliary server for offline training and support capabilities at the U.S. air defense sectors
  - Improved system capacities from 10,300 to 15,000 system tracks to support single sector continental United States operations

Mission

- NORAD and U.S. Pacific Command Commanders use BCS-F to execute command and control and air battle management in support of air sovereignty and air defense missions for North American Homeland Defense.
- Air defense operators employ BCS-F to conduct surveillance, identification, and control of U.S. sovereign airspace and control air defense assets, including fighters, to intercept and identify potential air threats to U.S. airspace.

Major Contractor

Thales-Raytheon Systems – Brea, California

Activity

- Air Combat Command completed an FDE of R3.1.3 at the System Support Facility at Tyndall AFB, Western Air Defense Sector, Eastern Air Defense Sector, Alaska Regional Air Operations Center, and the Hawaii Regional Air Operations Center in December 2011.

- The Air Force fielded R3.1.3 to all U.S. air defense sectors and Canada in December 2011.
- In September 2011, the Air Force's 92nd Information Operations Squadron (IOS) completed an insider threat assessment on R3.1.3.
- The Air Force conducted developmental testing on R3.2 at the System Support Facility at Tyndall AFB from July through October 2011 and January 2012. Additionally, the Air Force accomplished an IA certification test at this time. The Air Force also conducted developmental testing at the U.S. operational sectors from February through July 2012.
- The Air Force conducted system interoperability tests in November and December 2011 to evaluate datalink compliance with military standards.
- The Joint Interoperability Test Command is evaluating critical information exchanges in R3.2; testing started in April and will end in November 2012.
- In April 2012, the Air Force's 92nd IOS conducted penetration and vulnerability testing on R3.2 at the System Support Facility.
- The Air Force's 92nd IOS conducted an insider threat assessment on R3.2 at the Eastern Air Defense Sector in August 2012.
- From April through August 2012, the Air Force Operational Test and Evaluation Center (AFOTEC) conducted IOT&E on R3.2 at the System Support Facility and two U.S. operational sectors. Air Combat Command conducted FDE at the other two operational sectors.
- Air Combat Command began integrated developmental and operational testing of R3.2.1 at the System Support Facility in September 2012. The Air Force intends for R3.2.1 to provide a fix for a critical deficiency discovered during R3.2 operational testing. This deficiency causes a loss of situational awareness for the operators conducting surveillance of the National Capital Region and results in an inaccurate air picture. The Air Force designed R3.2.1 to provide the ability to operate with mandatory International Civil Aviation Organization flight plan changes scheduled for November 2012, and provide an update to local radar site information.
- AFOTEC and Air Combat Command conducted operational testing in accordance with a DOT&E-approved Test and Evaluation Master Plan.

Assessment

- DOT&E analyses of R3.1.3 concluded:
  - R3.1.3 is operationally effective and supports NORAD air defense operations, providing the ability to adequately perform core competencies and tasks required to accomplish the air defense mission.
  - R3.1.3 is operationally suitable with major shortfalls in logistics supportability, system documentation, and training. While training on datalink operations and combat identification have improved, system security training and training for differences in each new build still have major deficiencies.
  - Shortfalls in system security management and deficiencies in all IA assessment areas jeopardize secure system operations. Test results from the September 2011 insider threat assessment indicate R3.1.3 is deficient in the IA areas of protect, detect, react, and restore. The large number of outstanding deficiencies indicates the system's continued vulnerability to detect, withstand, or recover from attacks by cyber threats.
  - R3.1.3 demonstrated adequate reliability, maintainability, and availability. R3.1.3 has an average system availability of 99.98 percent, with over 1,118 hours of system operation during operational test.
  - Deficiencies still exist in R3.1 training for the intrusion detection system, the firewall, the local area network, the gateway manager, system doctrine, and combat identification. Additionally, R3.1 lacked adequate vulnerability management plans.
- A final assessment of R3.2 performance will not be available until all testing is completed in FY13 and DOT&E and the Air Force have analyzed the data. However, DOT&E preliminary analyses indicate:
  - A critical deficiency was discovered during operational testing at the Eastern Air Defense Sector. The BCS-F system did not reliably pass tracks to the Joint Air Defense Operations Center at Bolling AFB, Washington, D.C. This deficiency causes a loss of situational awareness for the operators conducting surveillance of the National Capital Region and results in an inaccurate air picture. The Eastern Air Defense Sector will not accept R3.2 until this deficiency is corrected. The Air Force planned to resolve this deficiency in R3.2.1, which underwent testing from September through October 2012.
  - R3.2.1 did not resolve the critical deficiency, and DOT&E assessed it as not effective and not suitable. The Air Force subsequently developed a new software release (R3.2.0.1), which completed testing at the end of November; preliminary data shows it fixed the critical deficiency. R3.2.0.1 also successfully demonstrated a temporary solution to operate with mandatory International Civil Aviation Organization flight plan changes. The permanent solution will be incorporated into R3.2.2. DOT&E will update the assessment of R3.2 once all test data has been received and analyzed.
  - Operational testing of R3.2 also uncovered the potential for BCS-F to provide inaccurate bearing and range information on an air track of interest. The effect of this deficiency is that commanders could make incorrect tactical decisions based on erroneous data. The operational sectors assessed this deficiency as critical, but Air Combat Command downgraded the severity and plans to implement a fix in R3.2.2, which the Air Force plans to start testing in January 2013.
  - Test personnel discovered six other critical deficiencies during R3.2 testing, but the Air Force paused testing,

developed a fix for each critical deficiency, and demonstrated each fix during subsequent test events.
- The BCS-F is required to demonstrate a Mean Time Between Critical Failure of 10,000 hours with an operational availability of 99.98 percent. Six critical failures occurred during 699 hours of operational testing at the System Support Facility and the Eastern and Western Air Defense Sectors. Total system downtime at the System Support Facility and Eastern and Western Air Defense Sectors was approximately 44 hours for an operational availability of 90.5 percent during operational testing, which users consider inadequate given the mission of BCS-F. However, the Air Force has subsequently demonstrated fixes for the failures causing the downtime.

Recommendations

- Status of Previous Recommendations. The Air Force satisfactorily addressed all but three of the previous recommendations. The Air Force still needs to:
  1. Correct and formalize all BCS-F Increment 3 system documentation and training deficiencies.
  2. Develop a plan for remote workstation management to include sustainment, training, documentation, and IA compliance.
  3. Upgrade the System Support Facility to support a more robust BCS-F developmental and operational testing capability in order to minimize the impact of overall testing at the operational sites.
- FY12 Recommendations. The Air Force should:
  1. Improve R3.2 reliability and operational availability until these suitability requirements are demonstrated with statistical confidence.
  2. Continue to track and correct IA deficiencies.
  3. Demonstrate the permanent solution for R3.2 to successfully incorporate and process International Civil Aviation Organization flight plans.
  4. Update the R3.2 Test and Evaluation Master Plan to reflect planning and FY13 funding for R3.2 follow-on testing.

C-5M

Executive Summary

- In February 2012, the Air Force completed a Force Development Evaluation of Operational Flight Program (OFP) 3.5 software combined with modifications to the engine thrust reversers. The C-5M with these upgrades is operationally effective, but it is still not operationally suitable.
- The C-5 Program Office is addressing deficiencies identified during previous operational tests, including problems with training systems and devices, Information Assurance, additional nuisance faults, the mission computers, the automatic throttles, and various maintenance Technical Orders through an extensive correction action plan. The Air Force plans to begin operational testing of OFP 3.5.2 in August 2013.
- The Air Force intends to award a contract for Core Mission Computer and Weather Radar upgrades in FY13.

System

- The C-5 is the largest four-engine military transport aircraft in the United States. The C-5 has 36 standard 463L pallet positions and airline seats for 81 passengers. It can carry a maximum payload of 270,000 pounds. The typical C-5 crew size is seven (two pilots, two flight engineers, and three loadmasters).
- The C-5M designation is the result of two separate but related modernization efforts:
  - The Avionics Modernization Program incorporates a mission computer, a glass cockpit with digital avionics (including autopilot and automatic throttles), and state-of-the-art communications, navigation, and surveillance components for air traffic management.
  - The Reliability Enhancement and Re-Engining Program provides over 50 reliability enhancements, plus commercial engines with new nacelles, thrust reversers, and pylons.

Mission

- Units equipped with the C-5 perform strategic airlift, emergency aeromedical evacuation, transport of brigade-size forces and equipment in conjunction with other aircraft, and delivery of outsize or oversize cargo (cargo that does not fit on a standard pallet).
- Units equipped with the C-5 execute missions at night, in adverse weather conditions, and in civil-controlled air traffic environments around the world. The units are capable of completing extended-range missions because the C-5 can receive in-flight aerial refueling.

Major Contractor

Lockheed Martin Aeronautics Company – Marietta, Georgia

Activity

- In February 2012, the Air Force completed a Force Development Evaluation of OFP 3.5 software combined with modifications to the engine thrust reversers in accordance with the DOT&E-approved test plan. OFP 3.5 is the second major modification to C-5M software.
- The Air Force made hardware modifications to the thrust reversers to address known deficiencies with deployment and retraction of the reversers.
- The Air Force began developmental testing of the next C-5M software version, Block 3.5.2, in May 2012 and plans to conduct operational testing in August 2013.
- The C-5 Program Office continues to address deficiencies identified during the C-5M initial operational tests in 2010, including training systems and devices, Information Assurance, additional nuisance faults, the mission computers, the automatic throttles, and various maintenance Technical Orders through a long-term corrective action plan.
- The Air Force intends to award supplier contracts for a new Core Mission Computer and a new Weather Radar in early FY13.

Assessment

- The C-5M is operationally effective with limitations. OFP 3.5 mitigates Environmental Control System Deficiency Reports, reduces nuisance faults related to the Engine Electronic Control, and marginally improves performance of the automatic throttles.
  - Operational problems remain that constrain throttle usage and increase pilot workload, including the automatic throttle's inability to "capture" a pre-set airspeed and the extent of airspeed deviations during critical flight conditions, such as final approach. OFP 3.5 modifications to the Environmental Control System and automatic throttles mitigated cabin pressure and cabin temperature fluctuations and reduced the very large throttle movements associated with the use of automatic throttles. However, failure to maintain a commanded airspeed during critical phases of flight remains a problem. The automatic throttle response improved with OFP 3.5 but still deviated outside specified criteria. During gusty or turbulent wind conditions, the automatic throttle had difficulty maintaining the set speed.
  - Prior to the recent modifications, the thrust reversers did not deploy reliably in flight due to the freezing of condensed water within the Center Drive Units of the thrust reversers. This condition limited the aircraft's capability for procedures such as rapid descent from high altitude and tactical descent in a combat zone. The Air Force installed a computer-controlled heater blanket on the Center Drive Units, which prevented ice formation and significantly increased the reliability of thrust reverser deployment in flight.
  - During developmental tests of the heater blanket, the thrust reversers exhibited retraction problems. If the reversers do not fully retract, the likelihood of a subsequent unintended deployment increases. Therefore, the engineers increased the retraction force and added mechanical snubbers (devices used to absorb excess force) to the thrust reversers. Now, the reversers deploy and retract reliably in flight, but require additional inspections.
- The C-5M is still not operationally suitable. The aircraft's ability to conduct the strategic airlift mission is hindered by deficiencies in the Automatic Flight Control System, by problems with the Embedded Diagnostics System (EDS) and built-in test (BIT) functionality, by inadequate support equipment, and by a lack of dedicated training systems. Deficiencies in several aspects of C-5M support functions, identified before the 2010 OT&E began, had a significant effect on suitability, specifically the maintainability of the aircraft. Planned fixes for the deficiencies described below remain in development:
  - BIT – a very high false alarm rate combined with a low fault isolation rate increased the time needed to troubleshoot and complete maintenance actions. BIT detections of critical faults did not meet the requirement of 99 percent during operational testing. Incremental improvements are underway.
  - Training Systems and Devices – aircrew and maintainer training devices specific to the C-5M are just becoming available two years after the Full-Rate Production decision. The Air Force uses one simulator and on-aircraft training to mitigate the shortage of aircrew simulators. Maintainers still have insufficient simulators and must conduct training on the aircraft, which is restricted by the aircraft availability. The Air Force intends to accredit simulators for both aircrews and maintainers in FY13.
  - Information Assurance – the C-5M is susceptible to Information Assurance problems. The additional risk from information operations on the EDS is low. Air Mobility Command is addressing the Information Assurance deficiencies in the interface of the EDS. Improvements are anticipated in the Block 3.5.2 and the Core Mission Computer upgrades.

Recommendations

- Status of Previous Recommendations. The Air Force is addressing all previous recommendations.
- FY12 Recommendations. The Air Force should:
  1. Continue to pursue comprehensive remediation programs for known capability deferrals/deficiencies in the C-5 modernization programs.
  2. Aggressively seek timely and technically accurate aircrew and maintenance training systems and documents for the C-5M.
  3. Regularly report on suitability improvements and shortfalls in both new and legacy C-5M subsystems.
  4. Correct the remaining BIT, EDS, and engine support equipment deficiencies.

C-130J

Executive Summary

- The C-130J is in production with periodic Block Upgrades to correct deficiencies and to provide capability enhancements.
- Improvements to the Station Keeping Equipment (SKE), verified in a second FOT&E, now enable the C-130J to perform formation airdrop missions in instrument meteorological conditions (IMC), correcting an effectiveness shortfall from the C-130J IOT&E in 2005.
- The Air Force conducted FOT&E of the Data Transfer and Diagnostics System (DTADS), which will replace the legacy computerized maintenance system, in order to correct suitability shortfalls from the IOT&E.
- The Air Force is correcting some deficiencies and adding new capabilities in the Block Upgrade 7.0. Delivery of the upgrade has continued to experience delays, now estimated to occur by 2QFY13. The Air Force has not funded subsequent deployment of Block Upgrade 7.0 to the fleet, and operational testing of the upgrade in FY13 remains undefined. This deferment affects several mission design series of the C-130J operated by the Air Force, Navy, and Coast Guard.

System

- The C-130J is a medium-sized four-engine turboprop tactical transport aircraft.
- Compared to previous models, the cockpit crew requirement is reduced from four to two on the J model; loadmaster requirements vary (one or two), depending on mission need.
- Compared to legacy models, the C-130J has approximately 70 percent new development. Enhancements unique to the C-130J include a glass cockpit and digital avionics, advanced integrated diagnostics, a new propulsion system, improved defensive systems, and an enhanced cargo handling system.
- The C-130J has two different lengths denoted as a long and a short body. The long body carries eight standard pallets; the short carries six.

Mission

- Combatant Commanders use the C-130J within a theater of operations for combat delivery missions which include:
  - Airdrop of paratroopers and cargo (palletized, containerized, bulk, and heavy equipment)
  - Airland delivery of passengers, troops, and cargo
  - Emergency aeromedical evacuations
- Combat Delivery units operate in all weather conditions, use night-vision lighting systems, and may be required to operate globally in civil-controlled airspace.

Major Contractor

Lockheed Martin Aeronautics Corporation – Fort Worth, Texas

Activity

- The Air Force is correcting deficiencies found in both developmental and operational testing and adding new capabilities in the Block Upgrade 7.0. Block Upgrade 7.0 continues to experience delays, with government developmental test and evaluation now expected to be complete by 2QFY13. The Air Force is deferring some deficiencies originally planned for correction in Block Upgrade 7.0 to Block Upgrade 8.1. The Air Force has not funded the deployment of Block Upgrade 7.0, which will likely become the technical baseline for the development of Block Upgrade 8.1. The Air Force has not fully defined plans for operational testing of Block Upgrade 7.0 and may limit operational testing to an operational assessment of limited capability enhancements in 3QFY13.
- The Air Force conducted FOT&E of the DTADS in October and November 2011 in accordance with the DOT&E-approved test plan. DTADS will replace the current computerized maintenance system (the integrated diagnostics system interface and Portable Maintenance Aid) that had suitability shortfalls during the C-130J IOT&E. DOT&E released a report on the DTADS FOT&E in October 2012.

- The Air Force conducted a second FOT&E of the SKE software enhancement from January to March 2012 in accordance with the DOT&E-approved test plan. DOT&E released reports on the first FOT&E in February 2012 and the second FOT&E in October 2012.

Assessment

- The Air Force decision not to deploy Block Upgrade 7.0 will affect all mission design series C-130J aircraft, including Air Force EC-, HC-, MC-, and WC-130J; Navy KC-130J; and Coast Guard HC-130J. Some future aircraft acquisitions that planned to incorporate Block Upgrade 7.0 modifications in the production line will have to be re-planned as kit installations at an increased cost and decreased aircraft availability.
- DTADS represents a significant improvement over the legacy maintenance support system in terms of usability, portability, diagnostic capability, and organic maintainability. Information Assurance shortfalls remain, particularly concerning the Windows XP® operating system used by DTADS and the procedures for handling potentially classified digital flight data recorder information. The Air Force cannot connect DTADS to government computer networks without a required Windows 7® update.
- The SKE has demonstrated significant improvement in successfully enabling formation flight in IMC, and some improvement in reliability. However, shortfalls remain in the troubleshooting and repair of SKE faults. The Air Force restricts formation flight in IMC to formations of only C-130J aircraft, limiting interoperability with legacy C-130 models.

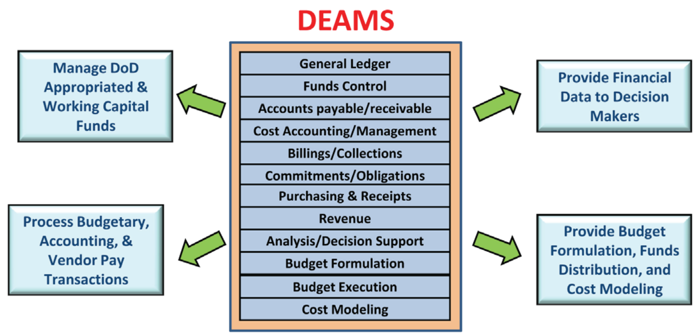
Recommendations

- Status of Previous Recommendations. The Air Force has made sufficient progress in addressing the FY11 recommendation to correct deficiencies in formation flying that will enable the SKE capability release. However, maintainability shortfalls remain in the troubleshooting and repair of SKE faults.
- FY12 Recommendations. The Air Force should:
  1. Correct remaining deficiencies in the technical data concerning the operation, fault isolation, and repair of the SKE system.
  2. Finalize plans for FY13 operational testing of Block Upgrade 7.0 and communicate them to DOT&E.
  3. Ensure adequate training and protocols are established for managing classified media associated with DTADS and digital flight data recorder downloads.

Defense Enterprise Accounting and Management System (DEAMS)

Executive Summary

- The Air Force Operational Test and Evaluation Center (AFOTEC) conducted an Operational Assessment (OA) of the Defense Enterprise Accounting and Management System (DEAMS) Increment 1 Release 1 from May through June 2012. The test locations included Headquarters U.S. Transportation Command (HQ USTRANSCOM) and Headquarters Air Mobility Command (HQ AMC), both located at Scott AFB, Illinois; and the Defense Finance and Accounting Service in Limestone, Maine. An Air Force team from the 688th Information Operations Wing conducted a limited Information Assurance (IA) vulnerability assessment at Maxwell-Gunter Annex, Alabama, on June 26, 2012.
- DEAMS is neither operationally effective nor operationally suitable. Many key features do not work, while other features often require intervention by subject matter experts to make them work.
- DEAMS successfully performs some decision support functions such as budget management within authority and funds distribution and loading. However, it does not adequately perform budget analysis and planning, decision analysis, balancing the General Ledger, not exceeding budget control targets, and generating accurate reports. Many users rely on legacy systems to create reports.
- DEAMS is neither making sufficient progress towards achieving audit readiness of the Statement of Budgetary Resources by the end of 2014, nor towards achieving full financial auditability by the statutory deadline of September 30, 2017.
- DEAMS could already be the target of fraud or theft due to inconsistent telecommuting policies, IA vulnerabilities, inadequate control of budget targets, and large account imbalances.
- DEAMS is unable to match Accounts Payable or Accounts Receivable, reconcile subsidiary accounts to the General Ledger (none reconciled), perform end-of-year accounting closeouts, or balance appropriation accounts accurately with Treasury appropriation accounts. However, DEAMS successfully ages and liquidates Accounts Receivable, capitalizes and depreciates assets when full information is available, and processes only valid data.
- DEAMS does not provide timely information to close out financial accounts at the designated end-of-period times; however, it records transactions quickly and pays vendors promptly.
- The presence of over 200 high-severity operational deficiencies indicates that the software is unstable. Many of the deficiencies are related to interfaces, indicating that DEAMS is not satisfying the end-to-end information exchange requirements of the Net-Ready Key Performance Parameter (KPP). However, DEAMS hardware is reliable and response times are acceptable.
- Three of seven previously-identified major IA vulnerabilities still require correction.
- DEAMS users are highly critical of user training and user documentation.



System

- DEAMS is a Major Automated Information System that uses commercial off-the-shelf Enterprise Resource Planning software to provide accounting and management services.
- The Program Management Office (PMO) is following an evolutionary acquisition strategy that adds additional capabilities incrementally. DEAMS Increment 1 consists of six releases. Release 1, which provides approximately 75 percent of the system's capability, is designed to meet the accounting and financial management needs of HQ USTRANSCOM and HQ AMC. Releases 2 through 6 intend to provide enhanced capabilities to support other USTRANSCOM locations.
- DEAMS operates on the Global Combat Support System – Air Force Integration Framework. It interfaces with approximately 40 other systems that provide travel, payroll, disbursing, transportation, logistics, acquisition, and accounting support.

Mission

- USTRANSCOM and Air Force financial managers will use DEAMS to compile and share accurate, up-to-the-minute financial management data and information across USTRANSCOM and the Air Force.
- USTRANSCOM, Air Force, and DoD leadership will use DEAMS to access vital, standardized, real-time financial data and information to make strategic business decisions.

- USTRANSCOM and the Air Force will use DEAMS to satisfy congressional and DoD requirements for auditing funds, standardizing financial ledgers, timely reporting, and reduction of costly rework.

Major Contractor

Accenture Federal Services – Fairborn, Ohio

Activity

- AFOTEC began, but did not complete, an Early Operational Assessment (EOA) of DEAMS from August through December 2010 in accordance with a DOT&E-approved test plan. AFOTEC cut the EOA short when it became apparent that major system deficiencies were present and that the planned Milestone B was significantly delayed.
- After the program manager declared that DEAMS had been stabilized, AFOTEC conducted a second OA of DEAMS Increment 1 Release 1 from May through June 2012 in accordance with a DOT&E-approved test plan. As with the EOA, the test locations included HQ USTRANSCOM and HQ AMC, both located at Scott AFB, Illinois; and the Defense Finance and Accounting Service in Limestone, Maine. DEAMS Increment 1 Release 1 contained approximately 75 percent of its final capabilities and had been in operational use for two years.
- An Air Force team from the 688th Information Operations Wing conducted a limited IA vulnerability assessment at Maxwell-Gunter Annex, Alabama, in June 2012.
- In July 2012, the DoD Inspector General reported (DoDIG-2012-111) that DEAMS's original life-cycle cost estimate had more than quintupled to over $2 Billion and that the program is 7.5 years behind schedule. In September 2012, another DoD Inspector General report (DoDIG-2012-140) found that DEAMS lacked critical functional capabilities needed to generate accurate and reliable financial management information and might not meet its 2014 and 2017 audit readiness requirements.
- DOT&E issued an OA report on DEAMS in September 2012. A Milestone Decision Authority decision followed immediately after, allowing the Air Force to deploy DEAMS to an additional 150 AMC users at McConnell AFB, Kansas.

Assessment

- AFOTEC conducted the FY12 OA of DEAMS Increment 1 Release 1 with the rigor of an IOT&E.
- DEAMS is neither operationally effective nor operationally suitable. Many key features do not work, while other features often require intervention by subject matter experts to make them work.
- Operational testers documented deficiencies in the areas of information quality, timeliness, and usability, along with many undocumented workarounds. DEAMS hardware is reliable and response times are acceptable, but the presence of more than 200 unresolved, high-severity deficiencies indicates that the software is still unstable, despite program attempts to resolve 245 prior high priority defects. According to the PMO, the fast tempo of delivery of software patches has not left any time for regression testing.
- Many of the software deficiencies are related to interfaces, indicating that DEAMS is not satisfying the end-to-end information exchange requirements of the Net Ready KPP.
- DEAMS is neither making sufficient progress towards achieving audit readiness of the Statement of Budgetary Resources by the end of 2014, nor towards achieving full financial auditability by the statutory deadline of September 30, 2017.
- DEAMS is unlikely to support financial operations because it does not meet the KPP for appropriations balance with the U.S. Treasury. Of 723 appropriation accounts examined, 109 had amounts out of balance for a total of $449 Million. DEAMS also does not meet the 95 percent KPP for General Ledger to subsidiary ledger reconciliation (none of the 49 samples reviewed were reconciled).
- DEAMS is unable to accurately match any Accounts Payable or Accounts Receivable documents and does not always prevent the posting of transactions that exceed Congressional appropriation funds control targets. AFOTEC identified two transactions that exceeded strict funds control by a total of $3 Million. However, DEAMS successfully ages and liquidates Accounts Receivable, capitalizes and depreciates assets when full information is available, and processes only valid data.
- DEAMS does not meet the KPP for timely reporting of period-end data to the official reporting system. DEAMS has not properly performed the end-of-year accounting closeouts for FY10 or FY11; however, it records transactions quickly and pays vendors promptly.
- DEAMS does not sustain financial decision support because it does not meet the KPP for fully accurate status of funds. While DEAMS successfully performs some decision support functions such as budget management within authority and funds distribution and loading, several important reports were inaccurate or incomplete. Many operators continue to use legacy systems, rather than DEAMS, to perform their daily tasks.
- DEAMS does not meet the KPP for budget control targets and is susceptible to fraud or theft. The additional in-test discovery of inconsistent telecommuting policies, IA vulnerabilities, and large account imbalances raise a concern that fraud or theft may be taking place.

- Three of seven previously-noted major IA vulnerabilities still require correction. Furthermore, some DEAMS users are telecommuting without using a Virtual Private Network.
- DEAMS users are highly critical of user training and user documentation.

Recommendations

- Status of FY11 Recommendations. The PMO and AFOTEC addressed all FY11 recommendations.
- FY12 Recommendations.
  1. The Air Force should conduct immediate "Financial Red Team" penetration testing to assess DEAMS's fraud and theft vulnerabilities. The test should address both prevention and detection of potential thefts or frauds.
  2. The Air Force should conduct immediate tests of the IA risks associated with telecommuting. The tests should determine whether perpetrators have attacked the system and extracted data. The PMO and the Defense Information Systems Agency should rectify all remaining IA deficiencies in order to reduce vulnerability.
  3. In order to prevent the accrual of new deficiencies, the Air Force should recreate a realistic developmental test environment that incorporates automated testing and allows the conduct of thorough, systematic, repeatable regression testing.
  4. The PMO and Functional Management Office should document any required workarounds authorized by the users. Similarly, the PMO should develop training to better meet individual user group requirements and improve user documentation to include workarounds and the legacy systems that are still needed for mission accomplishment.
  5. AFOTEC and the Joint Interoperability Test Command should collaborate to assess interoperability that covers full Net-Ready KPP requirements, including the end-to-end functional exchange of required information.
  6. The Air Force should not permit further deployments of DEAMS until substantial progress is made addressing the system's deficiencies.

E-3 Airborne Warning and Control System (AWACS)

Executive Summary

- The E-3 Airborne Warning and Control System (AWACS) provides airborne early warning, air surveillance, air battle management, and command and control without the beyond line-of-sight limitations inherent in ground-based air battle management systems.
- The Block 40/45 upgrade replaces the mission computing system on the E-3 with open-architecture, commercial off-the-shelf hardware including servers, and 15 mission crew interactive displays.
- The primary combat capability provided by the increased processing power of the Block 40/45 mission computing upgrade is to automatically fuse all onboard and off-board sensor inputs to provide a single track with a fused identification for each air, sea, and land entity using a multi-sensor integration algorithm.
- Block 40/45 is operationally effective. The modification provides many improvements for the operators, including automated tracking and identification. However, it did not provide the operators adequate control of the automated tracking capability. Additionally, it does not provide required enhancements to battle management capabilities, specifically the ability to automatically import data from the Air Operations Center to update the onboard database. It also does not provide Block 30/35 equivalent Link 16 datalink capabilities.
- Block 40/45 is not operationally suitable. During the IOT&E, the E-3 arrived on-station, on-time with both the radar and the Identification Friend or Foe (IFF) interrogation system functioning only one-third of the time. Operator and maintainer training were deficient and repair times exceeded requirements. Although Block 40/45 does not currently meet several key suitability requirements, Block 40/45 hardware is more reliable than the aging Block 30/35 equipment it replaces. Even when software failures are included, Block 40/45 is still more reliable than Block 30/35.

System

- AWACS is built on a Boeing 707 airframe. A surveillance radar and IFF system are located in the rotodome above the airframe. An Electronic Support Measures system has antennas on the cheeks of the airframe, under the nose, and in the tail. The E-3 has 13 Ultra High Frequency radios, 4 Very High Frequency radios, and 3 High Frequency radios.
- The Block 40/45 upgrade replaces the mission computing system on the E-3 with open-architecture, commercial off-the-shelf hardware including servers, and 15 mission crew interactive displays. The mission computing software program is replaced with a set of local area networked, open-architecture programs. The human-computer interface is built on the Windows® operating system and licenses the Raytheon Solipsys© Tactical Display Framework.
- The Block 40/45 mission computing upgrade provides the capability to automatically fuse all onboard and off-board sensor inputs to provide a single track for each air, sea, and land entity using a multi-sensor integration algorithm. The upgrade is also intended to provide:
  - An update to the E-3 AWACS Link 16 and satellite communications capabilities
  - Software to automatically refresh the onboard database
  - An updated mission system health monitoring tool
  - Improved interfaces and controls of the onboard passive Electronic Support Measure system
  - Improved mission planning and post mission processing capabilities
- The first six Block 40/45 E-3s are planned to have three different mission computing configurations. The Air Force plans to use the configuration of the seventh Block 40/45 E-3 to upgrade the next 11 jets.
- Block 40/45 requires several new ground support systems including the mission planning system, which the contractor delivered with the first upgraded aircraft. The contractor will deliver a deployable mission planning system before Initial Operational Capability in December 2013, in addition to trainers for maintenance personnel and mission crew.

Mission

The Air Component Commanders use AWACS-equipped units to:

- Provide early warning, air surveillance, air battle management, and beyond line-of-sight capabilities
- Provide command and control of offensive and defensive counterair and countersea operations, and strike missions

including dynamic targeting, close-air support, suppression of enemy air defenses, and strategic attacks
- Manage air refueling operations, combat search and rescue missions, and special operations missions

Major Contractor
The Boeing Company – Seattle, Washington

Activity
- During FY11, Boeing conducted developmental test and evaluation (DT&E) using the first production Block 40/45 E-3. Air Force Joint Task Force personnel were present at all qualification test events and had signature authority for pass/fail determination. This contractor-conducted DT&E consisted of seven flights from Boeing Field, Seattle, Washington. The focus of the final phase of DT&E was to verify changes made to the production system after the Air Force Operational Test and Evaluation Center (AFOTEC) published the 2007 Operational Assessment in support of the Low-Rate Initial Production decision.
- AFOTEC conducted a 24-flight IOT&E operating from the E-3 main operating base, Tinker AFB, Oklahoma City, Oklahoma, between March and June 2012. The IOT&E was conducted in accordance with the DOT&E-approved test plan. While there were no overnight deployments, the two operational Block 40/45 E-3s participated in several large force exercises. The Block 40/45 IOT&E included flights working with assets from all four Services in training areas on both coasts as well as over land.

Assessment
- Block 40/45 testing was adequate to support an evaluation of operational effectiveness and suitability.
- Block 40/45 was not ready to enter IOT&E. Contractor-conducted DT&E focused on specification compliance verification in lieu of a government-conducted DT&E, which could have assessed risks to a successful IOT&E outcome.
- Training was not representative of the syllabus intended for maintainers and aircrews. Operator and maintainer training simulators were not ready for IOT&E. The deployable mission planning system was also not available for the IOT&E. Additionally, documentation for both operators and maintainers was incomplete.
- Several Block 40/45 capabilities, including the mission planning system and start-up checklist, were never tested in DT&E. The Program Office never documented workarounds for use by aircrews during contractor DT&E, nor did they modify the system design to reflect changes in interoperability standards during Block 40/45 development.
- Block 40/45 is operationally effective. It provides some improvements for the operators, but not all the required enhancements. Block 40/45 provided automated tracking and combat identification, but did not provide the operators adequate control of the automated tracking capability. The crews were able to accomplish their battle management command and control missions throughout the IOT&E; however, Block 40/45 did not adequately provide the required capability to receive free-text data from the Air Operations Center and automatically import the data into onboard databases.
- Block 40/45 does not provide equivalent Link 16 capabilities to Block 30/35, which it replaces. AFOTEC discovered several interoperability deficiencies during the IOT&E. Many of the tactical datalink deficiencies were caused by the Air Force not modifying the system design to reflect changes in interoperability standards during Block 40/45 development. The satellite communications terminal did not provide an operationally useful capability to receive digital information.
- Block 40/45 is not operationally suitable. During the IOT&E, the Block 40/45 E-3 arrived on-station, on-time, with both the radar and IFF interrogation system functioning only one-third of the time. Block 40/45 system deficiencies caused half the missed on-station times, while legacy system deficiencies caused the other half.
- Block 40/45 demonstrated poor reliability. The Mean Time Between Critical Failure was 9 hours, which is significantly less than the threshold of 2,500 hours. Two-thirds of all critical failures occurred while starting the mission computing system. However, the Block 40/45 hardware is already more reliable than the Block 30/35 hardware it replaces (72-hour vice 4.6-hour Mean Time Between Unscheduled Maintenance (MTBUM)).
- When considering the addition of software failures and the reduction of Block 40/45 MTBUM, Block 40/45 is still more reliable than Block 30/35.
- Two ground repair actions were incomplete at the end of the IOT&E. One open repair action was for a legacy Block 30/35 part. The second open repair action was for a Block 40/45 part that was either not ordered or not provided for 14 days.

Recommendations
- Status of Previous Recommendations. This is the first annual report for this program.
- FY12 Recommendations. The Air Force should:
  1. Incorporate the most current datalink message standards into Block 40/45. This will allow Block 40/45 to have a datalink capability equivalent to the fielded legacy Block 30/35 AWACS fleet.
  2. Complete and update aircrew and maintenance checklists and technical orders to address the new failure modes discovered during IOT&E.

3. Modify the mission computing software and refine technician training to reduce the incidence of induced critical failures during Block 40/45 mission computing startup.
4. Develop software modifications to improve aircrew ability to control the automated tracking capability.
5. Review and update the planned training syllabus for both aircrew and maintenance personnel with information learned during the IOT&E.
6. Conduct FOT&E of Block 40/45 using the first Block 40/45 configuration that will be installed on more than two aircraft. The FOT&E should include an operationally representative deployment in a stressful tracking and combat identification environment.

F-15E Radar Modernization Program (RMP)

Executive Summary

- F-15E Radar Modernization Program (RMP) developmental flight testing began in January 2011 and IOT&E was expected to begin in late FY12. Although the RMP continued to make progress towards operational effectiveness, suitability, and mission capability during FY12, unanticipated software performance challenges in air-to-ground mapping, precision velocity update, and air-to-air target detection and tracking led to developmental test delays. As a result, the program will not begin IOT&E until mid-FY13.
- The Air Force resolved electromagnetic interference between the APG-82(V)1 Active Electronically Scanned Array (AESA) transmitter/receiver and the radios through the incorporation of software changes.
- The Air Force made progress in overcoming aircraft Environmental Control System (ECS) component failures and in-flight cautions noted in FY11 flight testing. RMP hardware performed nominally throughout FY12 developmental testing.

System

- The F-15E is a twin engine, tandem seat, fixed wing, all weather, multi-role fighter aircraft. The F-15E has a fully missionized cockpit and a multimode air intercept and air-to-ground radar, giving the aircrew the capability to employ air-to-air and air-to-ground munitions, a 20-millimeter cannon, and countermeasures for evading enemy fire.
- The RMP replaces the F-15E legacy APG-70 mechanically scanned radar with an AESA system designated the APG-82(V)1. The RMP is designed to retain functionality of the legacy radar system while providing expanded mission employment capabilities to include:
  - Near-simultaneous interleaving of selected air-to-air and air-to-ground functions
  - Enhanced air-to-air and air-to-ground combat identification capabilities
  - Longer range air-to-air target detection and enhanced track capabilities
  - Longer range and higher resolution air-to-ground radar mapping
  - Improved ground moving target track capability
- The RMP upgrade is also intended to address legacy F-15E radar system suitability shortfalls including: poor reliability, parts obsolescence, and high sustainment costs. The Air Force intends to retrofit the RMP across the existing F-15E fleet.
- The RMP APG-82(V)1 design leverages capabilities from currently fielded AESA radar systems. The APG-82(V)1 antenna and power supply are currently in use on the F-15C APG-63(V)3 program, and the radar receiver/exciter and Common Integrated Sensor Processor are based on the F/A-18E/F APG-79 AESA system.
- Other hardware and software modifications comprising the RMP effort include a more powerful ECS, updates to the aircraft Operational Flight Program and Electronic Warfare software, a new radio frequency tunable filter, and aircraft modifications to include a new wideband radome and wiring changes.

Mission

A unit equipped with the F-15E conducts all weather, day and night missions to include:

- Offensive and Defensive Counterair
- Conventional Air Interdiction and Nuclear Strike
- Close Air Support and Strike Coordination and Reconnaissance
- Suppression of Enemy Air Defenses
- Combat Search and Rescue

Major Contractors

- The Boeing Company – Saint Louis, Missouri
- Raytheon – El Segundo, California

Activity

- The Air Force conducted F-15E RMP testing in accordance with the DOT&E-approved Test and Evaluation Master Plan.
- Developmental flight testing begun in January 2011 extended throughout FY12. The planned FY12 IOT&E start did not occur due to challenges in maturing system software to meet the user's functional requirements.
- The Air Force resolved electromagnetic interference between the APG-82(V)1 AESA transmitter/receiver and the radios

through the incorporation of software changes. The Air Force verified the effectiveness of the corrective actions in subsequent FY12 developmental flight testing.
- The program experienced developmental challenges in maturing the integrated air-to-air and air-to-ground capabilities throughout FY12. Unanticipated software performance challenges in air-to-ground mapping, precision velocity update, and air-to-air target detection and tracking led to development delays. The Air Force has rescheduled IOT&E for March through July 2013.

Assessment
- The RMP continued to demonstrate incremental progress towards achieving the system's operational performance and suitability goals during FY12 developmental testing. However, the program experienced software maturation challenges and was unable to complete developmental testing in FY12. Unanticipated software performance shortfalls led to multiple radar OFP releases and associated regression testing to mature radar mode functionality. At the end of FY12, RMP performance had not yet met the user's requirements.
- Progress was made in overcoming aircraft ECS component failures and in-flight cautions noted in FY11 flight testing. Additionally, RMP hardware performed nominally throughout FY12.
- As noted in the DOT&E FY11 Annual Report, achieving the Air Force RMP software stability requirement by IOT&E may not be feasible. Multiple radar OFP version releases to correct system functionality shortfalls throughout FY12 precluded focus on stability requirements. As highlighted in the FY11 Annual Report, DOT&E continues to assess that the Air Force is not likely to meet the 30-hour Mean Time Between Software Anomaly requirement.

Recommendations
- Status of Previous Recommendations. The Air Force continues to address all previous recommendations.
- FY12 Recommendation.
    1. The Air Force should consider either amending the RMP 30-hour Mean Time Between Software Anomaly requirement or structuring the program (in particular, adding time and resources for additional development) such that it is able to achieve the desired performance measure.

F-22A Advanced Tactical Fighter

Executive Summary

- The Air Force Operational Test and Evaluation Center (AFOTEC) completed FOT&E of F-22A Increment 3.1 Enhanced Global Strike capabilities in November 2011. FOT&E results demonstrated that the enhanced air-to-ground hardware and software enable the F-22A to perform its intended offensive counter-air suppression of selected, but not all relevant enemy air defenses in Global Strike scenarios.
- Overall Increment 3.1 operational suitability was substantially improved compared with the performance in previous evaluation periods.
- The Air Force completed a formal investigation of the aircraft life support system and associated onboard oxygen generation system, and ruled out contamination as the root cause of hypoxia-like incidents that resulted in the fleet-wide F-22A grounding in FY11. The Air Force concluded that impedance/restriction caused by life support system elements were significant contributors to the physiological incidents and is pursuing actions to resolve the problem including: removal of the aircrew C21A filter pack, and testing of a modified aircrew upper pressure garment. Additionally, the Air Force is installing a back-up emergency oxygen system to provide emergency oxygen in the event of an environmental control system shut down, rapid decompression, or failure of the onboard oxygen generator.
- In conjunction with the completion of Increment 3.1 FOT&E and the F-22A fleet achieving its “at maturity” 100,000 fleet flight hours milestone, DOT&E conducted an analysis of F-22A progress in satisfying the original weapon system operational suitability requirements. Based on performance from IOT&E through Increment 3.1 FOT&E, DOT&E assesses the mature F-22A weapon system is operationally effective and suitable.

System

- The F-22A is an air superiority fighter that combines low observability to threat radars, sustained high speed, and integrated avionics sensors.
- F-22A low observability reduces threat capability to engage with current weapons.
- The aircraft maintains supersonic speeds without the use of an afterburner.
- Avionics that fuse information from the Active Electronically Scanned Array radar, other sensors, and datalinked information for the pilot enable employment of medium- and short-range air-to-air missiles, guns, and air-to-ground munitions.
- The Air Force designed the F-22A to be more reliable and easier to maintain than legacy fighter aircraft.
- F-22A air-to-air weapons are the AIM-120C radar-guided missile, the AIM-9M infrared-guided missile, and the M61A1 20 mm gun.

- F-22A air-to-ground precision strike capability consists of the 1,000-pound Joint Direct Attack Munition (JDAM) and the 250-pound Small Diameter Bomb (SDB) Increment One.
- The F-22A program delivers capability in increments. Incremental Enhanced Global Strike modernization efforts include the following current and projected increments:
  - Increment 3.1 provides enhanced air-to-ground mission capability, to include geo-location of selected emitters, electronic attack, air-to-ground synthetic aperture radar mapping and designation of surface targets, and SDB integration. Increment 3.1 is currently fielded in operational F-22A units.
  - Increment 3.2A is a software-only upgrade intended to provide improved Electronic Protection, Link 16, and Combat Identification capabilities in FY14. Increment 3.2A is a modernization effort within the scope of the F-22A Advanced Tactical Fighter baseline acquisition program of record.
  - Increment 3.2B is a hardware and software upgrade intended to integrate AIM-120D and AIM-9X missile systems, and provide additional Electronic Protection enhancements and improved emitter geo-location capability in FY17. Increment 3.2B will be a separate Major Defense Acquisition Program with Milestone B projected for December 2012.

Mission

A unit equipped with the F-22A:

- Provides air superiority over friendly or enemy territory
- Defends friendly forces against fighter, bomber, or cruise missile attack

- Escorts friendly air forces into enemy territory
- Provides air-to-ground capability for counter-air, strategic attack, counter-land, and enemy air defense suppression missions

Major Contractor

Lockheed Martin Aeronautics Company – Fort Worth, Texas

Activity

- The Air Force conducted F-22A testing in accordance with the DOT&E-approved Test and Evaluation Master Plan (TEMP) and FOT&E plans.
- The Air Force completed F-22A Increment 3.1 FOT&E in November 2011. Fleet-wide Increment 3.1 retrofits of Block 30 F-22As were ongoing throughout FY12.
- The Air Force completed a formal investigation of the aircraft life support system and associated onboard oxygen generation system due to several unexplained hypoxia-like incidents that occurred throughout FY11. Fleet-wide F-22A grounding from April through September 2011 delayed the planned completion of Increment 3.1 FOT&E until November 2011. The Air Force investigation ruled out contamination as the root cause of the incidents. As of August 2012, the Air Force concluded that impedance/restriction caused by life support system elements were significant contributors to the physiological incidents. Accordingly, the Air Force is pursuing the following actions in the interest of resolving the problem: removing the aircrew C21A filter pack, and testing a modified aircrew upper pressure garment. Additionally, the Air Force is installing a back-up emergency oxygen system to provide emergency oxygen in the event of an environmental control system shut down, rapid decompression, or failure of the onboard oxygen generator.
- The Air Force conducted planning activities in support of Increment 3.2A and 3.2B modernization efforts. Increment 3.2A developmental testing will begin in FY13. In conjunction with the completion of Increment 3.1 FOT&E and the F-22A fleet achieving its "at maturity" 100,000 fleet flight hours milestone, DOT&E conducted an analysis of F-22A progress in satisfying the original weapon system operational suitability requirements.

Assessment

Increment 3.1 FOT&E

- Results of Increment 3.1 FOT&E testing completed in November 2011 demonstrated that the enhanced air-to-ground capabilities enable the F-22A to perform its intended offensive counter-air suppression of enemy air defenses mission in Global Strike scenarios.
  - The F-22A remains capable of effectively employing legacy JDAM, AIM-9M, and AIM-120C weapons as well as the newly incorporated SDB.
  - Aircrews are capable of using the F-22A radar and onboard sensors to reliably locate and designate surface targets with sufficient accuracy to effectively employ both legacy JDAM and newly incorporated SDB munitions to suppress selected, but not all relevant enemy air defenses.
  - Overall Increment 3.1 operational suitability was substantially improved compared with the performance in previous evaluation periods. FOT&E demonstrated a significant improvement in Mean Time Between Critical Failure (MTBCF) compared to previous OT&E periods. Increment 3.1 FOT&E MTBCF was 4.68 hours (4.01 hours 80 percent lower confidence bound; 5.26 hours 80 percent upper confidence bound) compared to the reported MTBCF in the FY07 FOT&E of 1.73 hours.
  - The Increment 3.1 F-22A weapons system exceeded the operational deployability threshold requirement of seven C-17 airlift equivalents by one additional C-17.
  - The Increment 3.1 F-22A weapons system met both combat sortie generation requirements and material availability threshold requirements.

F-22A System At Maturity Assessment

- In conjunction with the completion of Increment 3.1 FOT&E, DOT&E assessed F-22A progress since the completion of IOT&E in satisfying the original weapon system's operational effectiveness and suitability requirements. Findings include the following:
  - Based on performance from IOT&E through Increment 3.1 FOT&E, DOT&E assesses the mature F-22A weapon system as operationally effective in both air-to-air and air-to-ground mission roles.
  - DOT&E compared Increment 3.1 FOT&E suitability results with operational F-22A unit performance through an independent model that simulated the combat sortie generation operations of an operational F-22A squadron. Based on suitability results achieved during Increment 3.1 FOT&E and results of the DOT&E model, DOT&E assesses that the mature F-22A weapons system is operationally suitable.
  - The Air Force has matured maintenance practices, improved subsystem suitability, adjusted manpower requirements, and modified the F-22A deployment concept of operations in order to meet F-22A combat air power needs. The F-22A weapons system is capable of achieving material availability and combat sortie generation Key Performance Parameter thresholds. However, based on increased maintenance manpower, equipment, and supplies necessary to sustain combat operations, the Air Force is likely to continue to require eight C-17 airlift equivalents to deploy an F-22A squadron in support of global operations.

Recommendations

- Status of Previous Recommendations. The Air Force continues to address all previous recommendations.
- FY12 Recommendation.
  1. Commensurate with the maturation of the F-22A weapons system and ongoing F-22A modernization efforts, the Air Force should apply past lessons learned for forthcoming F-22A upgrades, and the development and fielding of future manned fighter aircraft programs. Particular attention should be given to the challenges of maintaining low observable systems.

HC/MC-130J

Executive Summary

- DOT&E analysis of the IOT&E data was ongoing at the end of FY12. DOT&E expects to issue a Beyond Low-Rate Initial Production (BLRIP) report in 2QFY13 to inform the April 2013 Full-Rate Production decision.
- Preliminary IOT&E results indicate that the HC/MC-130J provides the capability to perform the combat search and rescue (CSAR) and Special Operations Forces (SOF) missions as well as or better than legacy aircraft in many aspects.
- Preliminary IOT&E results indicate that the HC/MC-130J met the required availability and mission capable rates, met the maintenance man-hour per flight hour requirement, and demonstrated a Mean Time Between Corrective Maintenance significantly better than the combat delivery C-130J fleet.
- Preliminary IOT&E results indicate that one aspect of aircraft survivability may be degraded relative to the legacy aircraft for the intended concept of employment.

System

- The HC/MC-130J is a medium-sized, four-engine turboprop tactical transport aircraft with hose and drogue aerial refueling, airdrop, and command and control capabilities. The core configuration is based on the Marine Corps KC-130J refueling tanker design with modifications including the ability to receive fuel in flight, a nose-mounted electro-optical/infrared sensor, and a combat systems operator flight deck station.
- The HC/MC-130J program delivers capability in increments. Increment 1 modifications include additional countermeasure dispensers, high-altitude ramp and door hydraulics, an additional (fourth) flight deck crew member station, an additional cargo compartment intercom panel, and cargo compartment 60-Hertz electrical outlets.
- The HC-130J will replace legacy HC-130P/N and MC-130P (rescue) aircraft; the MC-130J will replace legacy MC-130E/P aircraft. The Air Force intends to procure 37 HC-130Js and 94 MC-130Js.

Mission

- Air Combat Command (ACC) uses the HC-130J to support the personnel recovery mission through:
  - Aerial and ground refueling of vertical lift assets used during personnel recovery missions
  - Para-rescue jumper deployment with rescue-related equipment
  - Infiltration/exfiltration and resupply by airdrop or air land operations
- Air Force Special Operations Command (AFSOC) uses the MC-130J to support special operations missions requirements, including:
  - Aerial refueling and forward arming and refueling point operations of SOF rotary and tilt-rotor aircraft
  - Infiltration/exfiltration, resupply, or delivery of SOF personnel and equipment via airdrop or landing on austere, short runways in hostile or denied territory

Major Contractor

Lockheed Martin Aeronautics Company – Bethesda, Maryland

Activity

- Lockheed delivered 2 core configuration aircraft and 10 Increment 1 aircraft to the Air Force.
- The 46th Operations Group completed developmental test and evaluation (DT&E) of the core configuration aircraft in September 2011 and of the Increment 1 configuration, which was the production-representative test article for the IOT&E, in February 2012. The Increment 1 DT&E included regression testing of updated Operational Flight Program software on the new Sanders Technology and Advanced Risk Instruction Set Computer (STAR) IX mission computer hardware that is replacing STAR VII hardware throughout the C-130J fleet due to diminishing manufacturing sources.
- The Air Force Operational Test and Evaluation Center conducted IOT&E from March 1 through May 30, 2012, in accordance with the DOT&E-approved test plan. At least two full crews each from ACC and AFSOC flew two Increment 1 aircraft based at Cannon AFB, New Mexico. IOT&E included approximately 253 flight hours over 60 test missions, including a simulated deployment and arctic testing at Eielson AFB, Alaska; maritime testing at Hurlburt Field, Florida; and CSAR

exercises at Nellis AFB, New Mexico. Test scenarios included air land and airdrop delivery of personnel and cargo, aerial refueling as a receiver and as a tanker to helicopters and tilt-rotors, forward arming and refueling point operations, and defensive reactions to simulated threat engagements.
- The IOT&E also included scenarios for defensive engagements with prepositioned and mobile threat simulators to assess aircraft survivability equipment.

Assessment

- DOT&E analysis of the IOT&E data was ongoing at the end of FY12. DOT&E expects to issue a BLRIP report in 2QFY13 to inform the April 2013 Full-Rate Production decision.
- Preliminary IOT&E results indicate that the HC/MC-130J provides the capability to perform the CSAR and SOF missions as well as or better than legacy aircraft in many aspects. The improved propulsion system enables better tactical take-off performance from short, unimproved runways and expands the flight envelope for aerial refueling. The C-130J enhanced cargo handling system greatly improved loading, unloading, and airdrop operations relative to legacy aircraft. There were deficiencies in the following areas:
  - Current airdrop procedures result in very high workload and head-down time for the pilot monitoring airdrop and should be revised.
  - Crews commented that the lack of a tactical datalink, such as Link 16, limited their situational awareness. The C-130J Block Upgrade 7.0 was planned to provide Link 16, but the C-130J program has deferred fielding of Block Upgrade 7.0 until Block Upgrade 8.1 has been developed and tested.
  - Loadmasters have insufficient control over cargo compartment lighting, and the night-vision compatible lighting does not adequately support covert operations.
  - The location of some litter support strap hangers above the centerline overhead avionics equipment rack hinders configuration of the cargo compartment for medevac operations.
  - Lack of several specialized features for search and rescue missions relative to legacy aircraft (flare launcher tubes, large forward scanner windows, additional oxygen regulators and intercom panels) may require ACC or the Air National Guard to make modifications to the aircraft after delivery.
  - The intercom system does not transmit system tones (diagnostic or defensive system alerts) to all intercom panels in the cargo compartment, limiting loadmasters' situational awareness.
- Preliminary IOT&E results indicate that the HC/MC-130J met the required availability and mission-capable rates, met the maintenance man-hour per flight hour requirement, and demonstrated a Mean Time Between Corrective Maintenance significantly better than the combat delivery C-130J fleet.
- Preliminary IOT&E results indicate that one aspect of aircraft survivability may be degraded relative to the legacy aircraft for the intended concept of employment. Although the aircraft survivability equipment installed on the HC/MC-130J has been tested and employed on other C-130J aircraft, it may exhibit shortfalls under the new mission-specific concepts of employment.

Recommendations

- Status of Previous Recommendations. This is the first annual report for this program.
- FY12 Recommendations. The Air Force should:
  1. Address cargo compartment lighting control by loadmasters, including AFSOC's need for blacked-out cargo compartment lighting in covert operations.
  2. Develop mitigation plans for the deferred release of Block Upgrade 7.0, including the need for a tactical datalink.
  3. Develop plan to integrate improvements of aircraft survivability equipment in future increments.

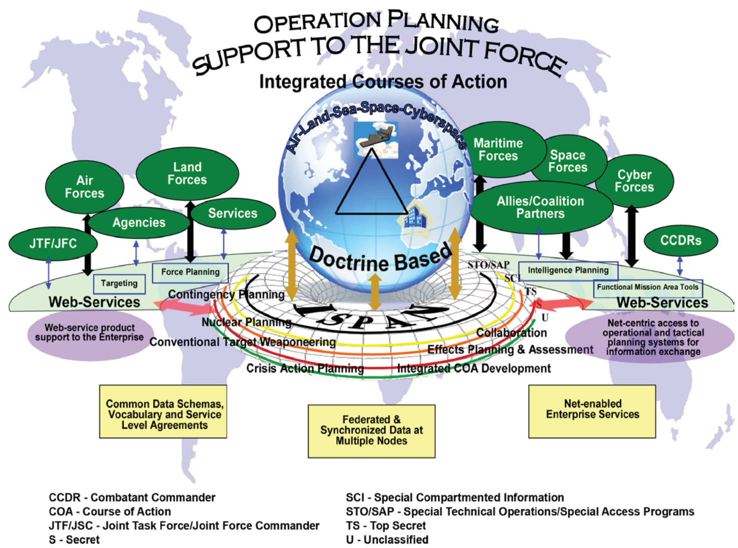
Integrated Strategic Planning and Analysis Network (ISPAN)

Executive Summary

- The overall Integrated Strategic Planning and Analysis Network (ISPAN) program consists of a system-of-systems approach that spans multiple security enclaves for strategic and operational-level planning and leadership decision making. ISPAN Increment 2 employed an agile acquisition approach that used two spirals to deliver this capability.
- U.S. Strategic Command (USSTRATCOM) and the Air Force Operational Test and Evaluation Center (AFOTEC) conducted an ISPAN Increment 2, Spiral 2, IOT&E in accordance with the DOT&E-approved test plan in July 2012.
- The IOT&E confirmed that the problems discovered during ISPAN Increment 2, Spiral 1, Integrated Test and Evaluation (IT&E), which USSTRATCOM and AFOTEC conducted in December 2011, were resolved.
- DOT&E assessed ISPAN Increment 2 as effective but not suitable due to system limitations involving software deficiencies, problematic configuration management processes, potential scalability deficiencies, and shortfalls in usability, timeliness, training, documentation, and maintenance of system interoperability.
- Web services provide interoperability functionality that can be unavailable when data structures are changed, interfaces are upgraded, or other events occur that affect how these services are implemented. The Program Office should negotiate service-level agreements between web interface partners to ensure that web services remain available and facilitate critical net-centric data exchanges.
- AFOTEC discovered a number of Information Assurance (IA) vulnerabilities during the IOT&E. The Program Office must promptly mitigate the two Category I IA vulnerabilities found during IOT&E and develop a plan of action and milestones to address the Category II and III findings.
- The Designated Accrediting Authority (DAA) reviewed the program manager-provided mitigation plan and issued an Authority to Operate on December 14, 2011. The Secretary of the Air Force granted a Full-Deployment decision in October 2012.

System

- The overall ISPAN program consists of a system-of-systems approach that spans multiple security enclaves for strategic and operational-level planning and leadership decision making.
- The ISPAN system is composed of two elements, which are developed in increments:
  - The Global Adaptive Planning Collaborative Information Environment (GAP CIE) that manages strategy-to-execution planning across all USSTRATCOM



    mission areas, which is being developed as part of Increments 2 and 3.
  - The Mission Planning and Analysis System (MPAS) that develops Joint Staff Level I through Level IV nuclear and conventional force application plans that support national and theater requirements, which will be modernized as part of Increment 4. Increment 4 is scheduled to begin development in FY14.
- Prior to Increment 2, the initial capabilities of GAP CIE and MPAS were fielded in ISPAN Block 1. After the fielding of ISPAN Block 1, the acquisition nomenclature was changed from a Block to Increment designation.
- ISPAN is employing an agile acquisition methodology, which delivers system capabilities in increments depending on user requirements. Increment 2 IOT&E consisted of approximately 40 percent of the planned system capabilities. The developers intend to deliver the remaining 60 percent in Increment 3, which is presently unfunded. USSTRATCOM intends to begin developing ISPAN MPAS capabilities in Increment 4.
- GAP CIE provides a web-enabled, net-centric collaborative environment for a contingency and crisis action planning (CAP) system at the Combatant Command (CCMD) and strategic level. The capability allows users from multiple CCMD staffs, subordinate commands, as well as other agencies, to collaborate online while providing planning and analyses to senior decision-makers.
- MPAS is intended to provide dedicated planning and analysis for all U.S. strategic nuclear forces, in addition to planning and analysis to create plans for specified theater and strategic conventional forces.

- The ISPAN Increment 2 provides an Adaptive Planning capability to CCMDs and subordinate planning partners, while decreasing contingency and CAP timelines to meet the DoD-approved Adaptive Planning and execution process, as well as time sensitive Global Strike and Prompt Global Strike planning requirements. The ISPAN Increment 2 is intended to improve information access through net-centric means for time critical event management support to senior decision-makers, and deliver the ISPAN GAP CIE capability as a service to the Enterprise, by exposing critical ISPAN information as Net-Centric Enterprise Services registered web services.

Mission

- USSTRATCOM uses ISPAN to perform deliberate and adaptive, strategic, nuclear, and non-nuclear planning and analysis. This includes developing the national deterrence war plans offering both nuclear and non-nuclear weapon options using the MPAS.
- The CCMDs, subordinate staffs, and other national agencies use GAP CIE for collaborative mission planning and analysis, course of action development, and commander's decision briefing preparation in support of CAP scenarios and time critical decisions regarding force employment.

Major Contractors

- Lockheed Martin – Papillion, Nebraska
- BAE Systems – Bellevue, Nebraska
- Northrop Grumman –Bellevue, Nebraska
- SAIC – San Diego, California

Activity

- USSTRATCOM and AFOTEC conducted an ISPAN Increment 2, Spiral 1 IT&E at USSTRATCOM, Offutt AFB, Nebraska, and the Combined Air Operations Center, Barksdale AFB, Louisiana, in December 2011. AFOTEC did not conduct the IT&E in accordance with a DOT&E-approved test plan and collected most data from a single Integrated Mission Area Training exercise, rather than the three CAP events planned. In addition, IA testing was not conducted.
- In July 2012, USSTRATCOM and AFOTEC conducted an ISPAN Increment 2, Spiral 2 IOT&E at USSTRATCOM, Offutt AFB, Nebraska; the Combined Air Operations Center, Barksdale AFB, Louisiana; and Headquarters, U.S. Southern Command, Miami, Florida. AFOTEC conducted the IOT&E in accordance with the DOT&E-approved test plan.
- The Secretary of the Air Force granted a Full-Deployment decision in October 2012.

Assessment

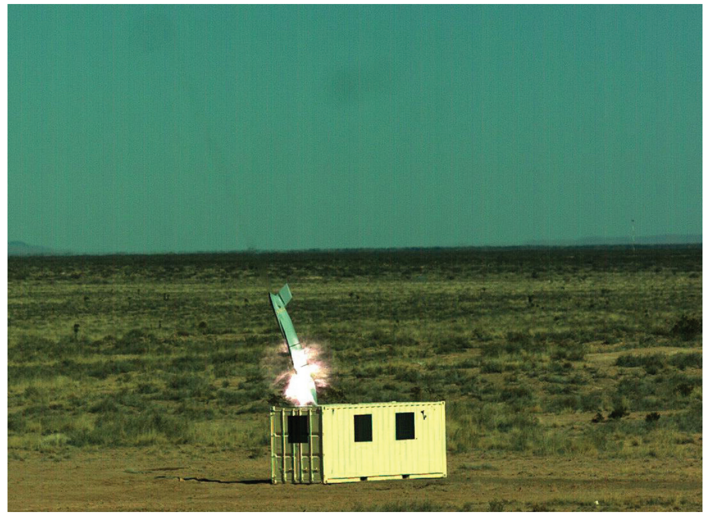
- CCMD staffs can effectively use ISPAN Increment 2 to provide improvements to the planning process to achieve operational outcomes. Users were able to accomplish all necessary planning functions in a collaborative manner, including users at two different locations.
- During IOT&E, the operational test team was able to complete the principal functions of the ISPAN Increment 2 system: the development of Courses of Action (COAs) and the integration of multiple COAs for the commander's approval.
- ISPAN Increment 2 was not suitable. The system limitations involved software deficiencies, problematic configuration management processes, potential scalability deficiencies, and shortfalls in usability, timeliness, training, documentation, and maintenance of system interoperability. During operational testing, ISPAN Increment 2 satisfied the requirements for reliability, availability, and maintainability (RAM). DOT&E assessed the areas of supportability, interoperability, transfer of operations, and RAM as operationally suitable. DOT&E noted that some of these limitations are requirements for Increment 3; however, since Increment 3 is presently unfunded, the system was assessed to the Capability Development Document requirement.
- In DOT&E's October 2012 IOT&E report on ISPAN, DOT&E assessed configuration management as not suitable due to AFOTEC's discovery of several configuration management shortcomings during developmental testing and IOT&E that affected the ISPAN mission. The most critical incident was when a 48-minute outage occurred during IOT&E because a maintenance contractor working on a switch within the system accidentally disconnected the system, which resulted in a critical failure of the system. Since the completion of IOT&E, the Program Office has put in place updated procedures to tighten configuration control of the system to prohibit these issues from reoccurring.
- ISPAN demonstrated the capability to support 370 concurrent users including simulated users performing ISPAN representative tasks with a server response time of 5 seconds or less. The concurrent user capacity is acceptable in view of the near term user levels of about 140 concurrent users during CCMD events. However, when the simulation was extended to a larger number of users, the server response time increased significantly. These results indicate a scalability problem, but it is unclear how many concurrent users would degrade the user experience below an acceptable level of responsiveness.
- Web services provide interoperability functionality that can be unavailable when data structures are changed, interfaces are upgraded, or other events occur that affect how these services are implemented.
- User feedback indicates that the test schedule did not provide adequate training time/exposure and documentation to all IOT&E participants; therefore, user training is not suitable. Some U.S. Southern Command users were unable to attend the training but those who did attend found it inadequate.

- AFOTEC discovered a number of IA vulnerabilities during the IOT&E. DOT&E recommended that the Program Office correct or mitigate the IA vulnerabilities to the satisfaction of the DAA prior to fielding. The Program Office continues to mitigate IA vulnerabilities.

Recommendations

- Status of Previous Recommendations. USSTRATCOM and the ISPAN Program Office have effectively addressed all previous recommendations.
- FY12 Recommendations. The following recommendations are from DOT&E's October 2012 IOT&E report.
  1. The Program Office must tightly control configuration management of the ISPAN baseline to prevent incidents and outages of the system.
  2. The Program Office needs to continue to diagnose and address system latency problems during operations and sustainment. As the ISPAN user community increases above the Increment 2 threshold, poor response times will affect the acceptance of this system.
  3. The Program Office must implement a robust training program to include classroom tutorial instruction and on-the-job training that is tailored to the need of each CCMD. Training should be provided to users with regards to what documentation is available and how to access it.
  4. The Program Office should negotiate service-level agreements between web interface partners to ensure that web services remain available and facilitate critical net-centric data exchanges. Web services can be unavailable when data structures are changed, interfaces are upgraded, or other events occur that affect how these services are implemented.
  5. The Program Office should support the service-level agreements with automated tests of availability of the web services.
  6. The Program Office must promptly mitigate the two Category I IA vulnerabilities found during IOT&E and develop a plan of action and milestones to address the Category II and III findings.
  7. The DAA should conduct an IA assessment for ISPAN in the Joint Worldwide Intelligence Communications System environment to ensure that no Category I vulnerabilities exist, all other vulnerabilities are identified, and plans for correction of deficiencies are created.

Joint Air-to-Surface Standoff Missile (JASSM)



Executive Summary

- The Air Force executed 16 AGM-158B Joint Air-to-Surface Standoff Missile – Extended Range (JASSM-ER) live fire shots in FY11 and 12, completing the IOT&E effort. All 16 prosecuted their targets successfully.
- The Air Force, in conjunction with the major contractor Lockheed Martin, is in the process of engineering development of the FMU-162/B Electronic Safe and Arm Fuze (ESAF) as a replacement for the mechanical fuzes currently used in JASSM.
- The Air Force completed AGM-158A Lot 6 Reliability Assessment Program (RAP) testing with three shots in FY12, two of which were successful, while one was terminated early to maintain range safety. There were three successful Lot 6 RAP shots in FY11 and one failed shot in FY10.
- The Air Force should continue to conduct RAP on Lot 8 and later via the Weapons System Evaluation Program (WSEP).

System

- The baseline AGM-158A JASSM is a stealthy cruise missile that flies a preplanned route from launch to a target, using GPS guidance and an internal navigation system. JASSM:
  - Has a 1,000-pound penetrating warhead
  - Has an imaging infrared seeker that can be used for greater accuracy and precision; the seeker uses image templates prepared by a rear echelon intelligence unit
  - Can be launched by B-1, B-2, B-52, F-15E, and F-16 aircraft
  - Includes a container that protects the weapon in storage and aids ground crews in moving, loading, and checking the missile
  - Uses the same Air Force mission planning systems used for aircraft and other weapons
- AGM-158B JASSM-ER is intended to fly longer ranges using a more efficient engine, larger capacity fuel tanks, and other modified components, all within the existing fuselage. JASSM-ER is currently integrated on the B-1.
- FMU-162/B ESAF takes advantage of advances in fuze technology and is intended to be a more reliable fuze with the same capabilities as the baseline mechanical fuze. The FMU-162/B ESAF would be used in JASSM baseline and ER variants.

Mission

- Operational units equipped with JASSM will employ the weapon from multiple aircraft platforms against high-value or highly-defended targets from outside the lethal range of many threats. Units equipped with JASSM will:
  - Destroy targets with minimal risk to flight crews and support air dominance in the theater
  - Strike a variety of targets greater than 200 miles away
  - Execute missions using automated preplanning or manual pre-launch retargeting planning
  - Attack a wide range of targets including soft, medium, and very hard (not deeply buried) targets
- Units with JASSM-ER will support the same missions as JASSM using a missile with a range more than twice as long.

Major Contractor

Lockheed Martin, Missile and Fire Control – Orlando, Florida

Activity

AGM-158A JASSM

- The Air Force certified JASSM for carriage and employment on the F-15E Strike Eagle. F-15E is the first JASSM-capable aircraft incorporating the Universal Armament Interface, a plug-and-play software that shortens the time required to integrate new weapons onto aircraft.
- There were three Lot 6 RAP test flight shots in FY12, two of which were successful, while one was terminated early to maintain range safety. Combined with the three successful FY11 shots and the single failed Lot 6 RAP test shot conducted early in FY10, this constitutes the completion of the Lot 6 RAP testing. The Lot 6 RAP tests used an

equal mix of re-worked early production Lot 6 missiles and current configuration Lot 6 missiles, ensuring adequate and equal testing of both variants.

AGM-158B JASSM-ER

- The Air Force executed 16 JASSM-ER live fire shots in FY11 and 12. All 16 JASSM-ER missiles engaged and destroyed their targets at both nominal and maximum JASSM-ER ranges.

FMU-162/B JASSM ESAF

- The FMU-162/B ESAF currently is funded by the major JASSM contractor. The Air Force, in conjunction with the major contractor, is in the process of re-design and engineering development of the FMU-162/B ESAF as an option to replace the existing mechanical fuze and thereby increase JASSM and JASSM-ER reliability.
- The Air Force conducted all testing in accordance with the DOT&E-approved Test and Evaluation Master Plan and test plan.

Assessment

AGM-158A JASSM

- An April 2011 DOT&E memorandum stated that the Air Force needed to execute a minimum of 6 RAP flights to demonstrate an 80 percent confidence level that Lot 6 is more reliable than Lot 5. Currently, the RAP shots following the first failure have been successful. Omitting the one flight that range-safety terminated due to crew error, RAP testing has demonstrated improved reliability over Lot 5.
- Despite improvements in workmanship and production processes, there is still a need to evaluate the inherent reliability of production lot missiles (through Lot 8, at a minimum) to ensure that the reliability growth plan is successful. The Air Force should accomplish Lot 8 and later RAP testing via the WSEP.

AGM-158B JASSM-ER

- The 16 JASSM-ER shots indicate that the JASSM-ER meets requirements. These 16 tests, in combination with 5 approved production-representative integrated test shots, successfully conclude the IOT&E. There was a single failure (IT-8) in 21 test events.

FMU-162/B JASSM ESAF

- The FMU-162/B ESAF program has the potential to increase the overall reliability of all JASSM variants. The FMU-162/B ESAF program would replace the current electro-mechanical fuze, which relies on moving parts prone to reliability failures. In addition, the FMU-162/B ESAF has more built-in test capability than the current electro-mechanical FMU-156/B ESAF.

Recommendations

- Status of Previous Recommendations. The Air Force continued to characterize the reliability of baseline missile production lots with the completion of the Lot 6 RAP.
- FY12 Recommendations. The Air Force should:
  1. In conjunction with the contractor, continue the development and evaluation of the FMU-162/B ESAF.
  2. Continue RAP for Lot 8 and later via the WSEP.

KC-46A

Executive Summary

- The KC-46A contract is firm-fixed-price with incentives for Engineering and Manufacturing Development. The Air Force awarded the contract to the Boeing Company in February 2011.
- The most recent DOT&E review of the post-Milestone B draft Test and Evaluation Master Plan (TEMP) indicates that the Air Force has made progress addressing test execution problems but further work is needed.
- The ALR-69A Radar Warning Receiver (RWR) has effectiveness shortfalls that require resolution prior to integration on the KC-46A.

System

- The KC-46A aerial refueling aircraft is the first increment (179) of replacement tankers for the Air Force's fleet of KC-135 tankers (more than 400). The KC-46A design uses a modified Boeing 767-200ER commercial airframe with numerous military and technological upgrades, such as the fly-by-wire refueling boom, the remote air refueling operator's station, additional fuel tanks in the body, and defensive systems. The KC-46A is intended to provide boom (pictured) and probe-drogue refueling capabilities. The Air Force intends to equip the KC-46A with an air-refueling receptacle so that it can also receive fuel from other tankers, including legacy aircraft.
- The KC-46A is designed to have significant palletized cargo and aeromedical capacities, chemical/biological/radiological/nuclear survivability, and the ability to host communications gateway payloads.
- Survivability enhancement features are incorporated into the KC-46 design. Susceptibility is reduced with an Aircraft Survivability Equipment suite consisting of Large Aircraft Infrared Countermeasures (LAIRCM), the ALR-69A RWR, and a Tactical Situational Awareness System. The suite is intended to compile threat information from the RWR and other on and off-board sources and prompt the crew with an automatic re-routing suggestion in the event of a threat. Vulnerability is reduced through the addition of fuel tank inerting and integral armor to provide some protection to the crew and critical systems.

Mission

Commanders will use units equipped with the KC-46A to:

- Perform air refueling to accomplish six primary missions: nuclear operations support, global strike, air bridge support, aircraft deployment, theater support, and special operations support. Secondary missions will include airlift, aeromedical evacuation, emergency aerial refueling, air sampling, and support of combat search and rescue.
- Operate in day/night and adverse weather conditions over vast distances to support U.S., joint, allied, and coalition forces.

Major Contractor

The Boeing Company, Commercial Aircraft in conjunction with Defense, Space & Security – Seattle, Washington

Activity

- The KC-46A Integrated Test Team has met quarterly since April 2011.
- Developmental, operational, and Federal Aviation Administration test planning are ongoing, with the most recent emphasis on developing an integrated test plan and a post-Milestone B TEMP.
- The Air Force submitted an operational assessment 1 plan. This assessment does not include flying since delivery of the first aircraft is not until June 2014.
- Survivability assessment planning is ongoing, integrating developmental, operational, and live fire testing and analysis. Susceptibility and vulnerability stakeholders are coordinating hardware-in-the-loop LAIRCM test planning to confirm system effectiveness using a modified 767 airframe model and to develop hit point distributions for the vulnerability assessment.
- The Air Force acquired two Boeing 767-200 assets for live fire testing at the Weapons Survivability Lab at China Lake,

California. The Air Force developed a comprehensive live fire test plan and began the ballistic test program in FY12 with two test series:
- A replica wing dry bay fire test series, completed in FY12 at Wright-Patterson AFB, Ohio, as part of a risk reduction effort to characterize various threats against KC-46 production materials
- Wing dry bay fire testing on a 767-200 production asset, which began on schedule in 3QFY12.

Assessment

- The most recent DOT&E review of the post-Milestone B draft TEMP indicates that the Air Force has made progress addressing test execution problems but further work is needed.
- The draft TEMP now allocates 5.5 months and 750 hours for operational testing, which is adequate for an effectiveness evaluation. To assess suitability, a statistically significant evaluation (at a 76 percent confidence) requires 1,250 flight hours; IOT&E may have to be extended to generate the required 1,250 flight hours if operationally representative field flight data are not available from other sources.
- The planned test program includes the following shortfalls that have been partially addressed but require complete resolution to gain DOT&E approval:
  - Concurrent activities and planned flying hours for the Engineering, Manufacturing, and Development program place a high demand on limited aircraft and simulator resources.
  - The planned effectiveness for military flight testing substantially exceeds the relevant historical experience. The planned 75 percent test effectiveness rate for military test points is not consistent with experience for flight testing of military aircraft. An average historical test effectiveness rate of 55 percent combined with 30 flight-hours-per-aircraft-per-month would extend the current 16-month schedule for military testing by approximately 4 – 7 months, a best-case estimate.
  - The Test Program Schedule in the draft TEMP has insufficient calendar time allotted for correction of discrepancies and/or deficiencies discovered during developmental testing prior to the planned start of operational testing.
  - The draft TEMP allocates insufficient resources (time and aircraft) for the initial training of aircrews and maintainers and technical order verification. Additional training time between the end of developmental test and the start of IOT&E is required.
- The susceptibility assessment will focus on LAIRCM effectiveness and situational awareness provided by the RWR and Tactical Situational Awareness System. Since the majority of data for the evaluation of susceptibility will come from contractor and developmental testing, and this testing is governed by the firm-fixed-price contract, increases in the scope of testing identified by DOT&E may require additional funding. The building block design of experiments approach taken for dry bay fire testing will provide a method for wing leading and trailing edge damage prediction that should be useful for reducing uncertainty in the model-based vulnerability assessment.
- The ALR-69A RWR was selected as Contractor Furnished Equipment by Boeing; however, integration and performance on the KC-46A are high risk. DOT&E recently completed an assessment of the ALR-69A RWR on the C-130H1 and assessed it as not effective, but suitable, in a separate classified report dated October 22, 2012. Not only do these effectiveness problems require correction, but the system is required to improve its geo-location capabilities as compared to the demonstrated C-130J capability.

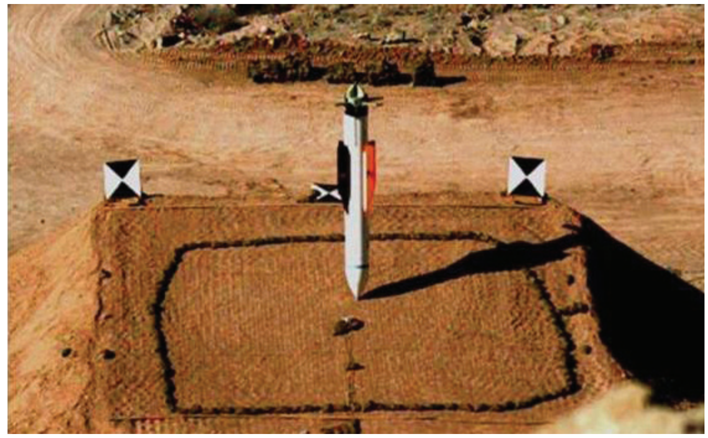
Recommendations

- Status of Previous Recommendations. The Air Force has addressed some of the FY11 recommendations to submit a TEMP incorporating realistic assumptions; however, additional work is needed.
- FY12 Recommendations. The Air Force should:
  1. Submit a TEMP with a realistic schedule mitigating the above mentioned shortfalls.
  2. Correct ALR-69A shortfalls prior to integration on the KC-46A.
  3. Plan to begin IOT&E at least six months later than the current draft TEMP indicates to allow for completion of developmental test and initial training.

Massive Ordnance Penetrator (MOP)

Executive Summary

- DOT&E published a classified Massive Ordnance Penetrator (MOP) Early Fielding report in April 2012 that summarized testing during FY08 through FY11, including five B-2 Quick Reaction Capability flight tests.
- The Air Force executed two MOP sled tests at the Holloman AFB High-Speed Test Track during June and August 2012 to confirm the successful re-design of certain aspects of the weapon system.
- The Air Force, between June and October 2012, successfully completed five additional weapon drops from the B-2 aircraft on threat-representative targets. The tests, conducted at the White Sands Missile Range, New Mexico, further defined weapon behavior against the target sets.



System

- The MOP, GBU-57A/B, is a large penetrating weapon with the ability to attack deeply buried and hardened bunkers and tunnels. The warhead case is made from a special high performance steel alloy and its design allows for a large explosive payload while maintaining the integrity of the penetrator case during impact.
- The B-2 Spirit is the only aircraft in the Air Force programmed to employ the MOP.
- The MOP is a GPS-guided weapon designed to reach and destroy targets located in well protected facilities. The MOP is more powerful than its predecessors, the BLU-109 and GBU-28.

Mission

Combatant Commanders use MOP to conduct pre-planned, day or night attacks against defended point targets vulnerable to blast and fragmentation effects and requiring significant penetration, such as hardened and deeply-buried facilities.

Major Contractor

The Boeing Company, Defense, Space & Security – St. Louis, Missouri

Activity

- The Air Force, using the Holloman AFB High Speed Test Track in New Mexico, conducted two sled tests during the June to August 2012 period, to confirm the successful re-design of a critical part of the weapon system.
- The Air Force executed five weapon drops at White Sands Missile Range, New Mexico, between June and October 2012, on threat-representative targets to further evaluate weapon system performance and to provide additional confirmation of the weapon re-design. During the tests, a B-2 conducted five drops: three with live warheads, and two with inert warheads. Telemetry data and visual observations indicate that all five weapon drops effectively prosecuted the targets.

Assessment

- In the April 2012 Early Fielding report, DOT&E concluded that the MOP is capable of effectively prosecuting selected hardened, deeply buried targets. All recommendations in the Early Fielding report have been addressed by the Air Force.
- The sled test results and the additional weapon drops indicate that the weapon re-design is adequate for the successful prosecution of all of the elements of the currently defined target set.

Recommendations

- Status of Previous Recommendations. This is the first annual report for this program.
- FY12 Recommendations. None.

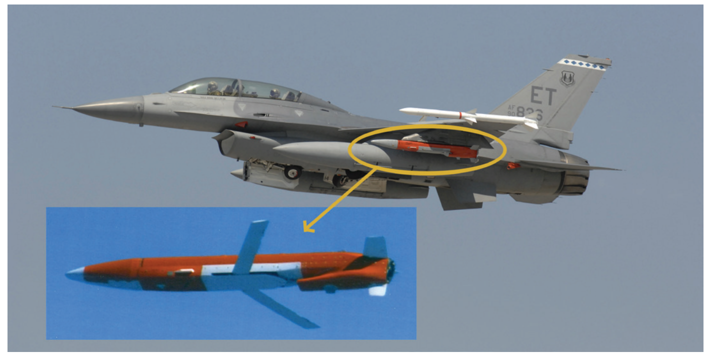
Miniature Air-Launched Decoy (MALD) and MALD-Jammer (MALD-J)

Executive Summary

- DOT&E's April 2011 IOT&E report assessed the Miniature Air-Launched Decoy (MALD) as operationally effective for combat, but not operationally suitable due to poor materiel reliability. In July 2011, the Air Force identified a fault with the missile's radio frequency connector that caused it to separate from the missile during long-endurance carriage flights. The Air Force has repaired the fault and conducted further reliability testing; however, MALD operational reliability of 78 percent remains below the 93 percent threshold requirement.
- The Air Force will no longer procure any MALDs, as the Program Office converted the MALD procurement line to MALD-Jammer (MALD-J).
- The Air Force demonstrated corrective actions for long-endurance carriage time failures with an additional MALD-J Engineering, Manufacturing, and Development (EMD) test mission in March 2012.
- The Air Force launched 14 MALD/MALD-J shots during FY12 without failure.
- Limited accessibility to test ranges, unavailability of threat systems, and delays in processing and evaluating data have hampered MALD and MALD-J testing. The Air Force needs to allocate sufficient range time for testing and reduce data processing turnaround times.

System

- MALD is a small, low-cost, expendable, air-launched vehicle that replicates how fighter, attack, and bomber aircraft appear to enemy radar operators. The Air Force will no longer procure any MALDs, as the MALD procurement line was converted to MALD-J.
- The Air Force designed the MALD-J as an expendable, close-in jammer to degrade and deny an early warning or acquisition radar's ability to establish a track on strike aircraft while maintaining the ability to fulfill the MALD decoy mission.
- The F-16 C/D and B-52 are the lead aircraft to employ MALD and MALD-J.



Mission

Combatant Commanders will use units equipped with:

- MALD and MALD-J to improve battlespace access for airborne strike forces by deceiving, distracting, or saturating enemy radar operators and Integrated Air Defense Systems.
- MALD to allow an airborne strike force to accomplish its mission by forcing enemy radars and air defense systems to treat MALD as a viable target.
- MALD-J to allow an airborne strike force to accomplish its mission by jamming enemy radars and air defense systems to degrade or deny detection of friendly aircraft or munitions.

Major Contractor

Raytheon Missile Systems – Tucson, Arizona

Activity

MALD

- In August 2011, the Air Force identified a fault with the missile's radio frequency connector that caused it to separate from the missile during long-endurance carriage flights. After improving the connector system, the Air Force tested MALD with six additional shots under a Reliability Assessment Program throughout FY12.
- The Air Force will no longer procure any MALDs, as the Program Office converted the MALD procurement line to MALD-J.

MALD-J

- In March 2012, the Air Force completed the MALD-J EMD with one additional test mission to ensure Operational Flight Software (OFS) Build-7a operated successfully and corrected all software anomalies found with the EMD.
- DOT&E approved the MALD-J IOT&E plan in May 2012.
- AFOTEC launched four MALD-Js during IOT&E in August 2012.

- The Air Force has conducted MALD-J testing to date in accordance with the DOT&E-approved Test and Evaluation Master Plan and test plan.
- The Air Force is currently working on modeling and simulation utilizing the Digital Integrated Air Defense System to evaluate MALD's ability to degrade an Integrated Air Defense System. Completion and final verification is scheduled for January 2013.

Assessment

- Limited accessibility to test ranges, unavailability of threat systems, and delays in processing and evaluating data have hampered MALD and MALD-J testing.

MALD

- The DOT&E assessment of MALD performance in the April 2011 MALD IOT&E Report remains unchanged. MALD performance is operationally effective for combat, but not operationally suitable due to poor materiel reliability in the intended operational environment.
- The six additional shots under the Reliability Assessment Program demonstrated no additional critical failures. However, the MALD reliability point estimate that combines free-flight and aircraft long-endurance carriage was 78 percent, which falls short of the threshold requirement of 93 percent. This reliability shortfall will increase the number of MALDs necessary to accomplish the mission.

MALD-J

- DOT&E conclusions regarding MALD-J suitability, particularly for reliability, depend in part upon data from MALD testing. DOT&E will use a combination of MALD and MALD-J data to evaluate whether the Air Force has resolved reliability problems. After completing MALD-J EMD, the Air Force launched 14 MALD and MALD-Js during FY12 without additional failures.
- Developing a full mission-level simulation (i.e., multiple MALD-Js versus multiple threat radars) is a technical challenge. However, the oversight of stakeholders and key leadership has helped the Air Force to continue development of the simulation capability in support of the AFOTEC MALD-J IOT&E.

Recommendations

- Status of Previous Recommendations. The Air Force is satisfactorily addressing four of the five FY11 recommendations. However, the remaining FY11 recommendation for the Air Force to provide sufficient resources to the Nevada Test and Training Range to enable personnel to process and distribute test data in a timely manner requires continued emphasis.
- FY12 Recommendation.
  1. Future strike aviation programs should consider utilizing the Air Force Digital Integrated Air Defense System modeling and simulation capability to accurately model the operational effect of MALD/MALD-J and other future weapons systems in robust scenarios.

Mission Planning Systems (MPS) / Joint Mission Planning Systems – Air Force (JMPS-AF)

Executive Summary

- The Air Force paused IOT&E of the E-8 Mission Planning Environment (MPE), the representative test platform for the Joint Mission Planning System – Air Force (JMPS-AF) Increment IV mission planning functionality, in September 2011 to allow the Program Office to develop and integrate corrective actions to deficiencies identified during operational testing.
- In January 2012, the DOT&E Major Automated Information System (MAIS) report documented deficiencies in the E-8 MPE version 1.0 realized during the suspended FY11 IOT&E. These deficiencies included incomplete printed flight plans, errors in flight calculations for station magnetic variation, problems with exporting mission flight plans, inadequate training for intelligence specialists, unreliable and time-consuming system setup and installation, and excessive time needed for routine maintenance.
- Following additional development and regression testing, the Air Force certified E-8 MPE version 1.3 ready for resumed operational testing. Air Force Operational Test and Evaluation Center (AFOTEC) will re-execute the entire IOT&E in early FY13 in accordance with the DOT&E-approved test plan.

System

- A Mission Planning System (MPS) is a Standard Desktop Configuration (SDC)-based common solution for Air Force aircraft mission planning (the current SDC is Windows XP® or Vista® PC-based). It is a package of common and platform-unique mission planning applications.
- An MPE is a set of developed applications built from a Framework, common components, and Unique Planning Components for a particular aircraft. The Framework is the basis of the MPE. Software developers add common components (e.g., Weather, Electronic Warfare Planner, etc.) and federated applications that support multiple users to the framework. Developers then add a Unique Planning Component for the specific aircraft type (e.g., E-8) to complete the MPE.

- The MPE can operate as an unclassified system or a classified system.
- Although the Framework software is being co-developed among DoD components, MPS is not a joint program. Each Service tests and fields its own aircraft-specific MPEs.
- The representative test platform for JMPS-AF Increment IV mission planning functionality is the E-8 MPE.

Mission

Aircrews use MPS to conduct detailed mission planning to support the full spectrum of missions, ranging from simple training to complex combat scenarios. Aircrews save the required aircraft, navigation, threat, and weapons data on a data transfer device that they load into their aircraft before flight.

Major Contractors

- Northrop Grumman – Carson City, California
- Boeing – St. Louis, Missouri
- TYBRIN Corporation – Fort Walton Beach, Florida

Activity

- The Air Force conducted all MPE operational testing in accordance with a DOT&E-approved Test and Evaluation Master Plan.
- AFOTEC did not complete IOT&E of the E-8 MPE version 1.0 due to deficiencies in: navigation functionality; magnetic variation computation; mission loading; take-off and landing computations; inadequate intelligence specialist training; unreliable system set up/installation; and excessive time needed for routine maintenance. AFOTEC returned the system to development for corrective action.
- The 46th Test Squadron at Eglin AFB, Florida, conducted developmental regression testing of E-8 MPE version 1.3 from

June through August 2012. The purpose of this test was to verify deficiency fixes, identify changes from the E-8 JMPS Version 1.0 MPE Report, and determine E-8 JMPS version 1.3 MPE readiness to resume IOT&E.

- Based on results from the E-8 MPE regression testing, the Air Force certified E-8 MPE version 1.3 ready for IOT&E in September 2012. AFOTEC will re-execute the IOT&E beginning in early FY13 in accordance with the DOT&E-approved test plan.

Assessment

- In February 2012, DOT&E published a MAIS report concluding that E-8 MPE version 1.0 was operationally suitable with limitations but not operationally effective. Significant findings included:
  - The time needed for E-8 MPE software installation was lengthy, due in large part to anomalies in the software functionality and installation process.
  - Threat database information was not easily accessible or usable. E-8 MPE training for intelligence specialists was inadequate.
  - While mission planners could use E-8 MPE version 1.0 to generate timely mission plans, they were unable to transfer some of these mission plans to the aircraft.
  - The MPE generated magnetic variation errors for user-specified waypoints. Developers identified critical calculation errors of the magnetic variation errors and incorporated fixes during 2012 developmental testing. AFOTEC will verify these corrections during the E-8 MPE version 1.3 IOT&E.
  - Mission planners could not plan missions with in-flight delays. Developers incorporated fixes during 2012 developmental testing and AFOTEC will verify these corrections during the E-8 MPE version 1.3 IOT&E.
  - The Take-Off and Landing Data (TOLD) module in E-8 MPE version 1.0, as well as in other platform MPEs tested and evaluated, does not generate accurate data and is not certified for flight use. The Automated TOLD capability is not integrated into version 1.3, and the Air Force has deferred incorporation of this objective capability to a future MPE release.

Recommendations

- Status of Previous Recommendations. The Air Force is addressing previous recommendations. However, the Air Force has yet to incorporate automated TOLD capabilities into the MPE.
- FY12 Recommendations. The Air Force should:
  1. Incorporate automated TOLD capabilities into the E-8 MPE.
  2. Re-execute the entire E-8 MPE IOT&E in accordance with the DOT&E-approved test plan in order to verify corrective actions and determine the system's operational effectiveness, suitability, and mission capability.

MQ-9 Reaper Armed Unmanned Aircraft System (UAS)

Executive Summary

- The MQ-9 Unmanned Aircraft System (UAS) continues to support ongoing global combat operations. The MQ-9 UAS has met urgent combat operational needs through accelerated production and the rapid incorporation of emergent sensor and systems technologies outside of the MQ-9 baseline program of record.
- The Air Force accelerated the planned FY13 Milestone C Decision for the Block 5 remotely-piloted aircraft (RPA) to September 2012. USD(AT&L) approved Block 5 RPA Milestone C and Low-Rate Initial Production in September 2012 and the MQ-9 UAS Increment One designation as an Acquisition Category 1C program in conjunction with the Milestone C decision.
- The Air Force Operational Test and Evaluation Center (AFOTEC) conducted an operational assessment (OA) of the Increment One UAS to inform the Block 5 RPA Milestone C decision. A limited flight demonstration comprising 5 functional capabilities sorties and 18 flight test hours demonstrated basic integration and functionality of the Block 5 RPA configuration to inform the Milestone C decision.
- Ongoing developmental challenges precluded operational testing and subsequent fielding of baseline program enhanced capabilities to operational MQ-9 units in FY12 (Operational Flight Programs (OFP) 904.2, 904.4, and Joint Direct Attack Munition (JDAM)).

System

- The UAS includes both the MQ-9 RPA and a Ground Control Station (GCS).
  - The MQ-9 RPA is a remotely-piloted, armed air vehicle that uses optical, infrared, and radar sensors to locate, identify, target, and attack ground targets. The RPA is a medium-sized aircraft that has an operating ceiling up to 50,000 feet, an internal sensor payload of 800 pounds, an external payload of 3,000 pounds, and an endurance of approximately 14 hours.
  - The GCS provides aircraft launch/recovery and mission control of sensors and weapons. C-band line-of-sight datalinks are used for RPA launch and recovery operations, and Ku-band satellite links are used for RPA mission control.

- The MQ-9 RPA carries AGM-114, Hellfire II anti-armor precision laser-guided missiles and GBU-12, 500 pound laser-guided bombs.
- The Air Force is using an evolutionary acquisition approach for meeting Increment One Capability Production Document (CPD) requirements, with Block 1 and Block 5 RPAs and Block 15 and Block 30 GCSs.
- The Air Force is currently fielding the Block 1 RPA.
- The Air Force designed the Block 5 RPA to incorporate improved main landing gear, an upgraded electrical system with more power, an additional ARC-210 radio, encrypted datalinks, a redesigned avionics bay and digital electronic engine control system, the BRU-71 bomb rack, high-definition video, and upgraded software to allow the two-person aircrew to operate all onboard systems.

Mission

- The Combatant Commander uses the MQ-9 onboard sensors and weapons to conduct armed reconnaissance and pre-planned strikes. Units equipped with MQ-9s can find, fix, track, target, engage, and assess critical emerging targets (both moving and stationary).
- MQ-9 units can also conduct aerial intelligence gathering, reconnaissance, surveillance, and target acquisition for other airborne platforms.

Major Contractor

General Atomics Aeronautical Systems Inc. – San Diego, California

Activity

- The Air Force conducted MQ-9 testing in accordance with the DOT&E-approved Test and Evaluation Master Plan.
- In July 2012, the Air Force Requirements Oversight Council approved changes to the MQ-9 reliability requirements. The Air Force changed the Mean Time Between Critical Failure threshold requirement from 500 hours to 19 hours for the MQ-9 RPA and from 500 hours to 224 hours for the GCS.

- MQ-9 Block 1 RPA software, Block 5 RPA hardware and software, and Block 30 GCS developmental testing were ongoing throughout FY12. The final MQ-9 Increment One UAS configuration will include the Block 5 RPA, Block 30 GCS, and OFP 904.6.
- Planned FY12 Air Force Air Combat Command (ACC) Force Development Evaluation (FDE) testing of MQ-9 Block 1 OFPs 904.2 and 904.4 did not occur. Software immaturity coupled with the implementation of new Air Force airworthiness requirements resulted in developmental delays.
- The 2009 GBU-38, 500-pound JDAM FDE to support limited MQ-9 fielding remains in a pause status pending resolution of MQ-9 OFP fuzing and weapons envelope discrepancies identified in 2010.
- The new Block 5 RPA completed five early developmental demonstration flights in FY12. These functional capabilities sorties demonstrated basic integration and functionality of the Block 5 RPA configuration.
- AFOTEC began an OA of MQ-9 in May 2012 in support of the September 2012 Block 5 Milestone C decision. AFOTEC conducted the testing in accordance with a DOT&E-approved OA plan.
- USD(AT&L) approved MQ-9 Block 5 RPA Milestone C and low-rate initial production in September 2012.

Assessment

- The Air Force intends to fulfill the MQ-9 Increment One CPD requirements with a final UAS configuration consisting of the Block 5 RPA, Block 30 GCS, and OFP 904.6. AFOTEC will conduct formal operational testing of the final MQ-9 Increment One UAS in 2014. This operational testing will assess Increment One UAS effectiveness, suitability, mission capabilities, and satisfaction of CPD key performance parameters.
- The MQ-9 program continues to face systemic challenges in prioritizing and maturing software OFPs to meet development and fielding timelines for the Increment One program of record. During FY12, such delays precluded the completion of developmental testing of OFPs 904.2 and 904.4 to support planned FY12 operational testing. Development, operational testing, and fielding of Increment One program of record capabilities will likely experience continued delays unless the program is able to better prioritize and control maturation of these capabilities.
- The program made incremental progress towards resolving deficiencies discovered during the 2009 MQ-9 JDAM FDE testing; however, the OFP has yet to demonstrate readiness for resumed JDAM operational testing.
- Findings from the AFOTEC OA of the Increment 1 Block 5 RPA indicated progress in conducting limited flight testing of the integrated hardware suite and early revisions of OFP 904.6 software in a prototype Block 5 RPA controlled with a Block 15 GCS. Across 5 sorties and 18 flight test hours these missions demonstrated:
  - Functional operation of aircraft handling, flight control systems, and payload systems
  - Successful operation of the heavyweight landing gear system
  - All power modes of the high capacity power system
  - Dual ARC-210 radio and wingtip antenna functionality in both clear and secure modes
  - Encrypted Ku-band satellite datalink control
  - Multi-spectral Targeting System B functionality in standard definition video format
  - Synthetic aperture radar legacy modes, including ground moving target indicator mode operation
- As was the case in FY11, Information Assurance (IA) vulnerabilities and deficiencies are not well characterized because the Air Force has only completed limited IA testing on the MQ-9 system. As of the end of FY12, the system is operating under an Interim Authority to Test, pending full system IA testing.

Recommendations

- Status of Previous Recommendations. In FY12, the Air Force satisfied several of the DOT&E FY11 recommendations. However, two FY11 recommendations remain outstanding:
  1. The Air Force should complete the JDAM FDE.
  2. The Air Force should conduct IA testing to include adversary system penetration testing.
- FY12 Recommendation

1. The Air Force should complete the development of the Increment One UAS hardware and software to support FOT&E of the Increment One system to assess operational effectiveness, suitability, and mission capability of the final Increment One UAS configuration.

RQ-4B Global Hawk High-Altitude Long-Endurance Unmanned Aerial System (UAS)

Executive Summary

Block 20

- The Air Force successfully completed conversion of two additional RQ-4B Block 20 air vehicles to the EQ-4B configuration equipped with the Battlefield Airborne Communications Node (BACN) payload. This increased the total number of BACN-equipped air vehicles supporting U.S. Central Command (USCENTCOM) operations to three. Developmental and operational testing of RQ-4B and EQ-4B Block 20 Global Hawk variants are complete.

Block 30

- The Air Force continued developmental testing of RQ-4B Block 30 capability upgrades and deficiency corrections at a reduced pace due to the FY13 budget proposal to terminate the program. The Air Force continued to improve RQ-4B Block availability by correcting air vehicle and sensor reliability problems and increasing the availability of spare parts.
- The Air Force has not conducted an RQ-4B Block 30 operational test to field deficiency corrections or previously planned new system capabilities to operational units since IOT&E in December 2010. Future plans for system development and testing depend upon final FY13 budget decisions.

Block 40

- The Air Force completed the initial phase of RQ-4B Block 40/Multi-Platform Radar Technology Insertion Program (MP-RTIP) radar system-level performance verification testing in July 2012, which demonstrated basic integration of the MP-RTIP radar with the Global Hawk air vehicle. This phase also focused on improving radar software stability, image quality, and moving target false alarm rates.
- In response to a USCENTCOM early operational need request, the Air Force is planning a limited operational utility evaluation in March 2013 to support early fielding of two developmental RQ-4B Block 40 systems to support USCENTCOM operations.

System

- The RQ-4 Global Hawk is a remotely-piloted, high-altitude, long-endurance airborne intelligence, surveillance, and reconnaissance system that includes the Global Hawk unmanned air vehicle, various intelligence and communications relay mission payloads, and supporting command and control ground stations.
- The RQ-4B Global Hawk Block 20 system is equipped with the Enhanced Integrated Sensor Suite (EISS) imagery intelligence payload. The EQ-4B Block 20 variant is equipped with the BACN theater communications relay payload. The EISS sensor includes infrared, optical, and synthetic aperture radar sensors for collecting still imagery intelligence on ground targets. The BACN payload provides communications connectivity between geographically separated operational units.
- The RQ-4B Global Hawk Block 30 system is equipped with a multi-intelligence payload that includes both the EISS imagery intelligence payload and the Airborne Signals Intelligence Payload (ASIP) electronic signal collection sensor.
- The RQ-4B Global Hawk Block 40 system is equipped with the MP-RTIP synthetic aperture radar payload designed to simultaneously collect imagery intelligence on stationary ground targets and track ground moving targets.

Mission

Commanders use RQ-4 Global Hawk reconnaissance units to provide high-altitude, long-endurance intelligence collection capabilities or theater communications relay capabilities to supported commanders.

- Operators collect imagery and signals data in order to support ground units and to identify intelligence essential elements of information for theater commanders. Units equipped with RQ-4B Global Hawk use line-of-sight and beyond line-of-sight satellite datalinks to control the Global Hawk system and transmit collected intelligence data.
- Distributed intelligence processing, exploitation, and dissemination systems receive intelligence data directly from the air vehicle or from the Global Hawk ground station via intelligence data transmission systems.

- Ground-based intelligence analysts exploit collected imagery and signals information to provide intelligence products in support of theater operations.
- Global Hawk can also provide imagery intelligence directly to forward-based personnel through direct line-of-sight datalink systems.

Major Contractor

Northrop Grumman Aerospace Systems, Strike and Surveillance Systems Division – San Diego, California

Activity

Block 20

- In response to a USCENTCOM request, the Air Force successfully completed conversion of two additional RQ-4B Block 20 air vehicles to the EQ-4B configuration equipped with the BACN payload to support USCENTCOM operations. The Air Force completed testing, and deployed these modified systems to USCENTCOM in FY12.
- Three of the four operational EQ-4B Block 20 air vehicles are now supporting USCENTCOM operations with the BACN payload. The fourth aircraft is a RQ-4B test asset. Developmental and operational testing of this Global Hawk variant is complete.

Block 30

- Due to the FY13 budget proposal to terminate RQ-4B Block 30 production and retire all existing aircraft, USD(AT&L) deferred the planned RQ-4B Block 30 Full-Rate Production Decision from August 2011 until at least November 2012.
- The Air Force continued developmental testing of software improvements to correct operational deficiencies identified during the FY11 IOT&E. However, the Air Force did not complete planned RQ-4B Block 30 Force Development Evaluation follow-on operational testing in FY11 or FY12 to evaluate and field these improvements due to uncertainty resulting from the FY13 budget proposal to terminate the program. The Air Force continued to implement corrective actions to improve system reliability, availability, and maintainability for the RQ-4B Block 30 systems currently employed in USCENTCOM, U.S. Pacific Command, and U.S. European Command operational theaters.
- The Air Force continued planning for an RQ-4B Block 30 Force Development Evaluation operational test in FY13 to evaluate specific post-IOT&E air vehicle and sensor software upgrades and a new satellite communications link. Planning for a more comprehensive FY14 RQ-4B Block 30/ASIP FOT&E event to evaluate correction of all major system deficiencies identified during IOT&E remains on hold pending a final decision on the future of the RQ-4B Block 30 program.

Block 40

- Due to FY13 budget uncertainties, USD(AT&L) deferred the RQ-4B Global Hawk Block 40 Milestone C Decision from August 2011 until FY13.
- In preparation for a Milestone C decision, the Air Force is developing a revised RQ-4B Block 40 Capability Production Document for Joint Staff approval, which removes Battle Management Command and Control mission capabilities as a threshold requirement and lowers overall system reliability and availability requirements. The Air Force also initiated development of an RQ-4B Block 40 Milestone C Test and Evaluation Master Plan to guide system developmental and operational test activities leading to a combined RQ-4B Block 40/MP-RTIP IOT&E in FY14 and FOT&E of future capabilities and system improvements.
- The Air Force continued execution of the current RQ-4B Block 40/MP-RTIP development and test program. The Air Force completed the first phase of RQ-4B Block 40/MP-RTIP radar system-level performance verification testing in July 2012 to verify basic integration of the MP-RTIP radar with the air vehicle platform. Additional radar control, performance, and interoperability testing is in progress and will continue until IOT&E in FY14.
- In response to a USCENTCOM early operational need request, the Air Force is planning a limited operational utility evaluation in March 2013 to support early fielding of two developmental RQ-4B Block 40 systems to support USCENTCOM operations.
- Accelerated delivery of RQ-4B Block 40 air vehicles and MP-RTIP sensor systems continued in FY12. The Air Force will accept delivery of at least 9 of the 11 procured RQ-4B Block 40 systems at Grand Forks AFB, North Dakota, prior to IOT&E and initial operational capability in FY14.

Assessment

Block 20

- Correction of previously identified EQ-4B air vehicle reliability problems and procurement of additional spare parts increased the system reliability and availability.

Block 30

- Due to FY13 budget uncertainties and lack of planned follow-on operational testing, the Air Force has not fielded software deficiency corrections or previously planned additional capabilities to operational units. Future plans for system development and testing depend upon final FY13 budget decisions.

- The Air Force continued to improve RQ-4B Block 30 reliability and availability by correcting air vehicle and sensor reliability problems and increasing the availability of spare parts. Maintenance training and technical order improvements also improved system maintainability. As a result, RQ-4B Block 30 mission capable rates increased from approximately 52 percent during the FY11 IOT&E to over 80 percent in FY12. At these rates, RQ-4B Block 30 effective-time-on-station performance at near continuous operational tempos should be sufficient to meet the minimum 55 percent effective-time-on-station operational requirement for single vehicle operations, if sufficient spare parts remain available.

Block 40

- The RQ-4B Block 40 and MP-RTIP development program made significant progress in FY12. The initial phase of radar system-level performance verification test in July 2012 demonstrated basic integration of the MP-RTIP radar with the air vehicle. This phase also focused on improving radar software stability, image quality, and moving target false alarm rates
- The RQ-4B Block 40/MP-RTIP test schedule to support early fielding of two systems to USCENTCOM in May 2013 and the FY14 IOT&E is aggressive with little room for recovery if ongoing developmental tests discover any significant system performance problems. Ongoing sensor data transfer and interoperability challenges and potential winter weather delays at the Grand Forks, North Dakota, test site further increase schedule risks.

Recommendations

- Status of Previous Recommendations. The Air Force made progress in addressing previous DOT&E recommendations to implement RQ-4B Block 30 system reliability, interoperability, and Information Assurance improvements. The Air Force delayed full implementation of the ASIP sensor performance improvement plans and other post-IOT&E RQ-4B Block 30 improvements due to the FY13 budget proposal to terminate the program. The Air Force successfully addressed DOT&E recommendations to revise RQ-4B Block 40 operational capability requirements and define related end-to-end operational architectures and interoperability requirements.
- FY12 Recommendations. The Air Force should:
  1. Develop an RQ-4B Block 30 test strategy to complete post-IOT&E corrective actions and conduct a comprehensive FOT&E if the decision is made to continue the program. If terminated, the Air Force should conduct FOT&E of the ASIP sensor on the U-2 aircraft to verify correction of serious performance deficiencies identified during IOT&E.
  2. Conduct an operational test to support early fielding of RQ-4B Block 40 developmental systems to meet the FY13 USCENTCOM operational need request.
  3. Complete an RQ-4B Block 40 Test and Evaluation Master Plan to guide system test activities leading to a combined RQ-4B Block 40/MP-RTIP IOT&E in FY14 and the required follow-on developmental and operational testing of planned future Global Hawk capabilities and system improvements.

Space-Based Infrared System (SBIRS) Effectivity 5

Executive Summary

- The Air Force Operational Test and Evaluation Center (AFOTEC) conducted an Operational Utility Evaluation (OUE) of the Space-Based Infrared System (SBIRS) from September 27 to October 11, 2012. The capability tested was Effectivity 5, which includes the SBIRS ground architecture, the first SBIRS satellite in geosynchronous orbit (GEO-1), two hosted infrared payloads in Highly Elliptical Orbit (HEO), and legacy Defense Support Program (DSP) assets. DOT&E published a classified test report in December 2012.
- The OUE will inform Air Force operational acceptance of Effectivity 5. U.S. Strategic Command will use operational test results for its Integrated Tactical Warning/Attack Assessment system certification. The National Geospatial-Intelligence Agency (NGA) will utilize operational test results for its certification of GEO-1 data for technical intelligence.
- SBIRS Effectivity 5 is operationally effective and will be operationally suitable upon resolution of an open deficiency identified in the classified DOT&E report.

System

The SBIRS program provides infrared sensing from space to support Department of Defense and other user organizations. The SBIRS program is being developed in two system increments to replace the DSP satellites:

- Increment 1 uses the SBIRS Control Segment and User Segment, operating with DSP satellites, to provide current military capability. Initial Operational Capability for Increment 1 was attained in December 2001, consolidating the operations of the DSP and Attack and Launch Early Reporting to Theater missions.
- Increment 2 includes a space segment consisting of two hosted payloads in HEO and four satellites in geosynchronous orbit. Increment 2 also provides new software and hardware to process data from both the DSP and the SBIRS space segment.
- Increment 2 capabilities are being delivered in phases, both with ground system software and on-orbit assets, and therefore require several dedicated test and evaluation activities. The current phase tested, Effectivity 5, adds capabilities into the operational SBIRS system to support GEO-1, which was launched on May 7, 2011. New capabilities include GEO-1 command and control functions and use of GEO-1 scanner sensor data in mission processing and reporting functions.

Mission

Combatant Commanders, deployed U.S. military forces, and allies intend to use SBIRS to conduct missions that require improved space sensors and operational launch detection capabilities. Commanders will use SBIRS to enhance support to joint combat forces in four key areas:

- Timely and responsive space-based missile warning and detection
- Launch detection and characterization for missile defense operations
- Technical intelligence
- Battlespace awareness

Major Contractor

Lockheed Martin Space Systems – Sunnyvale, California

Activity

- AFOTEC conducted a dedicated OUE from September 27 through October 11, 2012. AFOTEC conducted the testing in accordance with the DOT&E-approved Test and Evaluation Master Plan (TEMP) and test plan. The OUE was executed in conjunction with Air Force Space Command's operational trial period. An initial period occurred from September 27 through November 27, 2012. An additional trial period is projected to occur following resolution of a deficiency affecting suitability, which is discussed in the classified report.
  - The capability tested was Effectivity 5, which includes the SBIRS ground architecture, GEO-1, two hosted infrared payloads in HEO, and legacy DSP assets.
  - DOT&E published a final test report in December 2012. The report will inform Air Force operational acceptance

of Effectivity 5. U.S. Strategic Command will also use operational test results for its Integrated Tactical Warning / Attack Assessment system certification. NGA will utilize operational test results for its certification of GEO-1 data for technical intelligence.

- The Air Force successfully launched SBIRS GEO-1 on May 7, 2011, and conducted planned checkout and sensor tuning activities through May 2012 for the strategic and theater missile warning missions. Additional checkout activities are planned to continue throughout FY13, including testing and calibration of the staring sensor.
- DOT&E approved an updated Enterprise TEMP on March 7, 2012. Another update to the TEMP is in coordination for future testing of Increment 2. Finalizing this document is contingent upon a ground architecture definition, a concept of operations, and operational requirements for each key SBIRS Increment 2 delivery.
- AFOTEC and the SBIRS Program Office led an Integrated Test and Evaluation period between June and August 2012. The Air Force made modeling and simulation requirements a priority, working with the Program Office and contractor to ensure required capabilities were sustained and available for Integrated Test.

Assessment

- SBIRS Effectivity 5 is operationally effective. Integration of GEO-1 into the operational constellation improved accuracy of both strategic and theater missile warning mission data and did not degrade overall mission performance. SBIRS also demonstrated improved performance against the missile defense mission. SBIRS support to the technical intelligence and battlespace awareness missions was functional and effective. There were no major problems observed during the integrated and operational test periods. The SBIRS enterprise system accomplished its strategic and theater missile warning missions, successfully detecting and reporting all missile events during both real-world and simulation scenarios during these test periods.
- The SBIRS GEO-1 scanning sensor payload is meeting accuracy and sensitivity requirements, based on developmental and integrated test activities. It is at least as capable as legacy DSP sensors, while providing detection over a given location twice as frequently. This increased revisit rate is operationally significant as it enables the ability to determine target missile type with higher confidence by providing more data points for analysis during the target missile's powered flight.
- SBIRS Effectivity 5 will be operationally suitable upon resolution of an open deficiency identified in the classified DOT&E OUE report. The Air Force is addressing problems identified during the OUE with the overall system, technical intelligence missions, and specific Information Assurance postures.
- The classified test report includes more information on additional observations, detailed findings, and recommendations

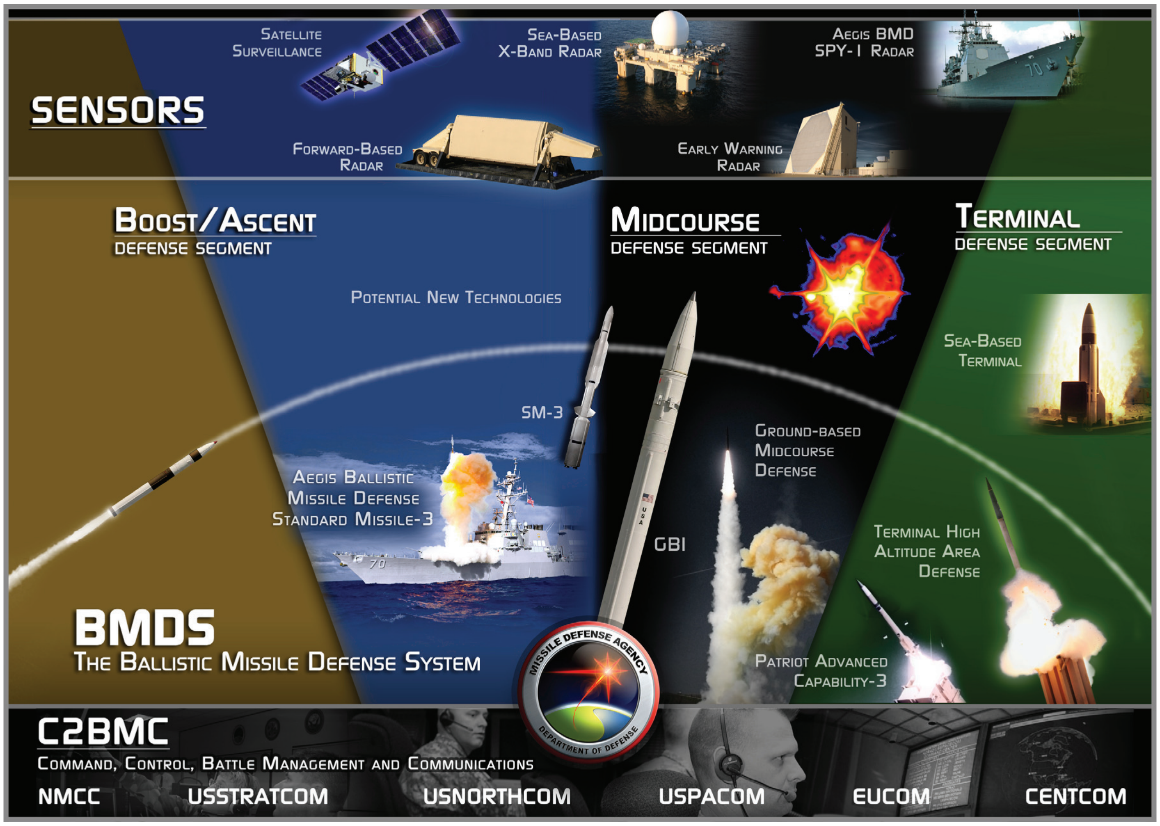
Recommendations

- Status of Previous Recommendations. The Air Force satisfactorily addressed previous recommendations from FY05, FY07, FY08, and FY09.
- FY12 Recommendations. The Air Force should
  1. Specify the ground architecture, concept of operations, and operational requirements for each key SBIRS Increment 2 delivery due to recent SBIRS restructuring to support a timely update of the TEMP.
  2. Address the eight recommendations identified in the December 2012 classified DOT&E OUE report.

Ballistic Missile Defense Systems

Ballistic Missile Defense Systems

Ballistic Missile Defense System (BMDS)



Executive Summary

- In October 2012, the Missile Defense Agency (MDA) conducted the most complex ballistic missile defense flight test, combined developmental/operational Flight Test Integrated-01 (FTI-01), ever attempted in the history of the DoD. FTI-01 was the first flight test of a regional Ballistic Missile Defense System (BMDS) that included soldiers, sailors, and airmen from multiple Combatant Commands operating multiple sensors and missile defense systems to engage three ballistic and two cruise missile targets near simultaneously. Four of the five targets were successfully intercepted. Analysis is ongoing, but DOT&E will include the results in the 2012 BMDS report to Congress to be published in February 2013.
- Except for FTI-01, testing of the BMDS during the past fiscal year was limited to three ground tests, two Aegis BMD flight tests, one Terminal High-Altitude Area Defense (THAAD) flight test, and exercise Fast Eagle Increment 1 testing. The Ground-based Midcourse Defense (GMD) program did not accomplish any element flight testing.
- BMDS regional defensive capability was enhanced by completion of FTI-01, deployment of Phase 1 of the European Phased Adaptive Approach (EPAA), and the lessons learned during exercise Fast Eagle Increment 1.
- The MDA, in collaboration with the Operational Test community, continued to refine the content and quality of the BMDS Integrated Master Test Plan (IMTP) with emphasis on the verification, validation, and accreditation of the models and simulations supporting performance assessments.

System

- The current BMDS architecture integrates ballistic missile defense capabilities against all ranges of threats.
- BMDS is a distributed system currently comprised of five elements (four shooter elements and one command and control element) and five sensor systems (four radar systems and one space-based system).

Elements

- Aegis BMD (shooter)
- Command, Control, Battle Management, and Communications (C2BMC) (command and control)
- GMD (shooter)
- Patriot (shooter)
- THAAD (shooter)

Sensors

- Aegis BMD AN/SPY-1 Radar
- Cobra Dane Radar
- Upgraded Early Warning Radars
- AN/TPY-2 (Forward-Based Mode [FBM]) Radar
- Space Based Infrared System/Defense Support Program (SBIRS/DSP)
- These two sensor systems will support the BMDS when available:
  - Sea-Based X-Band Radar (primarily a test asset that can be operationally deployed as needed)
  - Precision Tracking Space System (a projected addition to the BMDS sensor systems)

Mission

- The U.S. Strategic Command (USSTRATCOM) synchronizes operational-level global missile defense planning, operations support, and the development of missile defense effects for the DoD. When directed, it provides alternate missile defense execution.
- U.S. Northern Command (USNORTHCOM), U.S. Pacific Command (USPACOM), U.S. Central Command (USCENTCOM), and U.S. European Command (USEUCOM) will employ the assets of the BMDS to defend U.S. territory, deployed forces, friends, and allies against ballistic missile threats of all ranges and in all phases of flight. Initial capability permits defending U.S. territory against simple ballistic missile threats and defending deployed forces, friends, and allies from theater-level ballistic missile threats.
- USSTRATCOM, USNORTHCOM, USEUCOM, USCENTCOM, and USPACOM will use the C2BMC element of the BMDS to maintain situational awareness. USEUCOM, USCENTCOM, and USPACOM will also use the C2BMC to provide sensor management of theater AN/TPY-2 radars across the full mission engagement space.
- The Army employs Patriot to provide theater defense for deployed forces against short- and medium-range threats.

Major Contractors

- The Boeing Company, Integrated Defense Systems, Missile Defense Systems – Huntsville, Alabama
- Lockheed Martin:
  - Missile and Fire Control – Dallas, Texas
  - Mission Systems and Sensors – Moorestown, New Jersey
  - Information Systems and Global Solutions – Gaithersburg, Maryland
- Raytheon Missile Systems – Tucson, Arizona

Activity

- The MDA conducted FTI-01 in October 2012, which included near-simultaneous Aegis BMD and Patriot engagements of short-range ballistic missiles while defending against cruise missile attacks, and a THAAD first time engagement of a medium-range ballistic missile. SBIRS/DSP provided early warning and an AN/TPY-2 (FBM) radar provided acquisition cues via C2BMC. Soldiers performed command and control functions from the Air and Space Operations Center at Hickam AFB, Hawaii.
- In FY12, the MDA completed the Ground Test-04d (GT-04d) campaign, which consisted of Ground Test Integrated–04d Part 2 in October 2011 and Ground Test Distributed-04d (GTD-04d) Parts 2 and 3 in December 2011. These ground tests provided support to the MDA's European Phased Adaptive Approach (EPAA)-Phase 1 declaration against medium-range ballistic missiles and NATO's May 2012 declaration of an interim southern European missile defense capability.
- The MDA completed GTI-04 (Israel) in November 2011, which tested the interoperability of Israel's joint BMDS. It integrated the following U.S. and Israeli systems: C2BMC, Aegis BMD, AN/TPY-2 (FBM), SBIRS/DSP, THAAD, and a representation of the Israeli Arrow Weapons System.
- The MDA completed Ground Test Focused-04e (GTX-04e) in April 2012. This developmental ground test provided data to assess new functionality for Aegis BMD, GMD, and THAAD.
- The MDA completed the Fast Eagle Increment 1 hardware-in-the-loop testing in June 2012, a distributed test in August 2012, and follow-on hardware-in-the-loop testing in September 2012. These tests were designed to evaluate the capability of the AN/TPY-2 (FBM) and USCENTCOM C2BMC to augment the existing USCENTCOM BMDS capability.
- The MDA, in collaboration with the Operational Test community, made one update to the FY12 version of the BMDS IMTP that uses a critical factors analysis (referred to as Critical Engagement Conditions) and other important data needs (referred to as Empirical Measurement Events) to drive test design, planning, and execution. In July 2012, the MDA began a process of re-baselining the IMTP to better align it with BMDS modeling and simulation verification, validation, and accreditation data needs. The MDA conducted testing during FY12 in accordance with the DOT&E-approved IMTP.
- In FY11, the MDA established a Lethality Focus Group (LFG) in which the MDA, DOT&E, and the Operational Test community collaborate to identify lethality data gaps for all BMDS weapon elements. In FY12, the LFG generated a prioritized list of threat models needed to support lethality evaluations for planned flight and ground testing for Aegis BMD, GMD, Patriot, and THAAD, and has started developing a plan of action to address these data voids.
- During FY12, the MDA conducted numerous wargames and exercises that enhanced Combatant Command BMD readiness and increased confidence in the deployed elements of the BMDS. These events included: Air and Missile Defense Exercise (AMDEX), Joint Air and Missile Defense

Exercise, Austere Challenge, Terminal Fury/Global Lightning, EUCOM AMDEX, Keen Edge, Ulchi Freedom Guardian, Vigilant Shield/Global Thunder, BMDS Wargame, Planning Exercise, Joint Tactical Air Picture, National Missile Defense Conference, Nimble Titan, Joint Deployable Integrated Air and Missile Defense, Integrated Air and Missile Defense Center Senior Level Seminar, Huntsville Wargame, and the Missile Defense Advisory Committee Wargame.
- To support operational testing beginning in FY13, the MDA completed major infrastructure improvement and modernization efforts at the Reagan Test Site (RTS) and on Wake Island. At RTS these include: development of Mission Operations Centers; upgrade of power, water, and fuel infrastructure to support THAAD, Patriot, and AN/TPY-2 radar sites in various locations on the Kwajalein Atoll; development of housing and dining facilities for Soldiers who will man the THAAD and Patriot batteries; a climate-controlled storage facility; improvement and modernization of housing for flight test personnel; and installation of communications infrastructure to support mission data and voice communications. On Wake Island these include: refurbishment of the 50k Rail Launcher; improvement and upgrade of the backup power systems; and repair and improvement of the existing communications infrastructure.

Assessment
- Many of the models and simulations used in the ground tests are still not accredited for performance assessment, thereby limiting quantitative assessments based on their results. Re-baselining the IMTP to better align it with BMDS modeling and simulation will support required verification, validation, and accreditation.
- The BMDS defensive capability against theater threats increased during the last fiscal year. The deployment of an AN/TPY-2 (FBM) radar to Turkey and an Aegis BMD ship to the Mediterranean Sea provided an interim defensive capability in the southeastern Europe theater, which was demonstrated through ground testing (although these ground tests have not been accredited for performance assessment). Similar ground testing provided evidence for an initial defensive capability for the Israeli and Middle Eastern theaters as well. During FTI-01, sensors and weapon systems worked together successfully to engage four of the five targets launched during the test scenario contributing to this assessment. Only Aegis BMD was unsuccessful while engaging a short-range ballistic missile. DOT&E anticipates continued increases in this capability over time.
- BMDS interoperability increased during the last fiscal year to support the additional defensive capabilities in the European, Israeli, and Middle Eastern theaters. Ground testing (GT-04 campaign and Fast Eagle Increment 1) uncovered some interoperability and command and control deficiencies that affected track processing, situational awareness, and battle management. The MDA is currently investigating these deficiencies.
- The BMDS capability against strategic threats has not increased because the GMD program continues to resolve deficiencies with its Capability Enhancement II (CE-II) Exo-atmospheric Kill Vehicle (EKV). As a result, the GMD program did not conduct a flight test in FY12.
- The designated Service members actively participated in system-level BMDS testing, as well as element-level testing. They perform operational roles at individual element levels through major Combatant Command levels using operational tactics, techniques, and procedures.
- Although the LFG has developed a plan of action to address BMDS lethality data voids, the MDA has made little progress in retiring lethality data needs.

Recommendations
- Status of Previous Recommendations. Although the MDA has made progress on previous recommendations, the FY08 recommendation regarding the BMDS lethality program and the FY09 recommendation regarding IMTP execution are still valid. The FY11 recommendation regarding flight testing to verify root causes and Failure Review Board results for Aegis BMD and GMD flight tests failures has been partially met for the Aegis BMD program, and is still being addressed for the GMD program.
- FY12 Recommendation.
  1. The MDA should continue addressing the interoperability and command and control deficiencies uncovered during the GT-04 test campaign and FTI-01. Resolution of these deficiencies should be demonstrated through ground and/or flight testing.

Aegis Ballistic Missile Defense (Aegis BMD)

Executive Summary

- The Aegis Ballistic Missile Defense (BMD) program completed the initial phase of developmental flight testing of the Aegis BMD 4.0.1 and 4.0.2 defense capabilities with Standard Missile-3 (SM-3) Block IB interceptors, and it commenced a phase of combined developmental and operational testing (DT/OT) for the 4.0.1 and 4.0.2 system and interceptor.
- The Aegis BMD program conducted four intercept missions in FY12; three were successful and one failed.
- Although the program completed the FOT&E phase for the Aegis BMD 3.6.1 system in FY11, the system continued to take part in BMDS-level tests related to Phase 1 of the European Phased Adaptive Approach (EPAA) and other system-level deployments.
- Aegis BMD continued to improve interoperability with other Ballistic Missile Defense System (BMDS) elements and sensors during flight and ground testing in FY12.
- Hardware-in-the-loop (HWIL) ground testing demonstrated potential Aegis BMD capability to contribute to theater-level defense missions spanning a range of ballistic missile defense scenarios.

System

- Aegis BMD is a sea-based missile defense system that employs the multi-mission shipboard Aegis Weapon System, with new radar and missile capabilities to engage ballistic missile threats. Capabilities of Aegis BMD include:
  - Computer program modifications to the AN/SPY-1 radar, which allow long-range surveillance and track (LRS&T) of ballistic missiles of all ranges.
  - A modified Aegis Vertical Launch System, which stores and fires SM-3 Block IA and Block IB interceptors (on select ships), and modified SM-2 Block IV interceptors (on select ships).
  - SM-3 Block IA and Block IB interceptors, which use a maneuverable kinetic warhead to accomplish midcourse engagements of short-, medium-, and intermediate-range ballistic missiles.
  - Modified SM-2 Block IV interceptors, which provide terminal engagement capability against short-range ballistic missiles.

- Aegis BMD is capable of performing autonomous missile defense operations, operations that exploit networked sensor information, and can send or receive cues to or from other BMDS sensors through tactical datalinks.

Mission

The Navy can accomplish three missile defense-related missions using Aegis BMD:

- Defend deployed forces and allies from short- to intermediate-range theater ballistic missile threats
- Provide forward-deployed radar capabilities to enhance defense against ballistic missile threats of all ranges by sending cues or target track data to other elements of the BMDS
- Provide all short- to long-range ballistic missile threat data to the Command, Control, Battle Management, and Communications (C2BMC) system for dissemination to Combatant Commanders' headquarters to ensure situational awareness

Major Contractors

- Lockheed Martin Maritime Systems and Sensors – Moorestown, New Jersey
- Raytheon Missile Systems – Tucson, Arizona

Activity

- In accordance with the DOT&E-approved Integrated Master Test Plan, the Aegis BMD program completed the initial phase of developmental flight testing of the Aegis BMD 4.0.1 and 4.0.2 defense capabilities with SM-3 Block IB interceptors, and it commenced a phase of combined DT/OT for the 4.0.1 and 4.0.2 system and interceptor.
- Although the program completed FOT&E for the Aegis BMD 3.6.1 system in FY11, the program continued to use

the 3.6.1 system in BMDS-level tests related to Phase 1 of the EPAA and other system-level deployments.

- The Aegis BMD program conducted four intercept missions in FY12; three were successful and one failed:
  - During Flight Test SM-16 (FTM-16) Event 2A in May 2012, an Aegis BMD 4.0.1 cruiser intercepted a short-range non-separating ballistic missile target with an SM-3 Block IB interceptor. The FTM-16 Event 2A engagement was the first intercept of a ballistic missile with the SM-3 Block IB interceptor and Aegis BMD 4.0.1 system.
  - During FTM-18 in June 2012, an Aegis BMD cruiser with 4.0.1 software intercepted a simple separating ballistic missile target with an SM-3 Block IB interceptor. FTM-18 was the second successful intercept mission conducted with the new Aegis BMD 4.0.1 system with an SM-3 Block IB interceptor, and the first combined DT/OT flight test for that system.
  - During Flight Test Integrated-01 (FTI-01) in October 2012, an Aegis BMD 3.6.1 ship performed a near-simultaneous engagement of a short-range simple separating ballistic missile target with an SM-3 Block IA interceptor and an anti-air warfare target with an SM-2 interceptor. FTI-01 was the first integrated flight test with multiple firing elements (Aegis BMD, Terminal High-Altitude Area Defense [THAAD], and Patriot) engaging multiple ballistic missile and air-breathing targets in a realistic BMDS-level architecture. While the SM-3 Block IA interceptor missed its target, the SM-2 interceptor achieved a successful intercept.
- In FY12, Aegis BMD participated in several flight and ground tests to assess Aegis BMD 3.6.1 and 4.0.1 system functionality and interoperability with the BMDS:
  - Ground Test Integrated-04d (GTI-04d) Part 2 in October 2011 tested the engagement capabilities of existing missile defense systems against short- and medium-range ballistic missiles and tested system-level sensor resource management and tasking in an HWIL environment in support of an EPAA Phase 1 assessment. Participants included Space-Based Infrared System/Defense Support Program (SBIRS/DSP), Aegis BMD (laboratory sites with 3.6.1 software), AN/TPY-2 (Forward-Based Mode [FBM]), and C2BMC.
  - The MDA completed GTI-04 (Israel) in November 2011, which tested the interoperability of Israel's joint BMDS. It integrated the following U.S. and Israeli systems: Aegis BMD 3.6.1, C2BMC AN/TPY-2 (FBM), SBIRS/DSP, THAAD, and a representation of the Israeli Arrow Weapons System.
  - During Flight Test THAAD (FTT)-12 in October 2011, an Aegis BMD laboratory representation was utilized to assess the capability of Aegis BMD 3.6.1 to conduct simulated engagements against separating and non-separating short-range ballistic missiles using track data from the Space Tracking and Surveillance System (STSS).
  - Ground Test Distributed-04d (GTD-04d) Part 2 in December 2011 tested the communication architecture that was deployed as part of EPAA Phase 1. Participants included a laboratory representation of Aegis BMD 3.6.1, and AN/TPY-2 (FBM) and C2BMC assets in a distributed environment using operational communication systems and operationally representative crews.
  - GTD-04d Part 3 in December 2011 tested interoperability and engagement capability of the EPAA Phase 1 system in support of deployment. Participants included Aegis BMD (3.6.1 laboratory representation), AN/TPY-2 (FBM), and C2BMC in a distributed environment using operational communication systems and operationally representative crews.
  - Aegis BMD 3.6.1 participated in the FTM-15 System-level Post-Flight Reconstruction (SPFR) in December 2011, which was a BMDS HWIL-based event designed to provide data in support of modeling and simulation anchoring efforts.
  - Aegis BMD 4.0.1 laboratory representations participated in Ground Test Other-04e (GTX-04e) in March and April 2012. GTX-04e provided the necessary HWIL architecture for testing new engagement and LRS&T capabilities of Aegis BMD 4.0.1. The test integrated C2BMC, Ground-based Midcourse Defense, AN/TPY-2 (FBM), Patriot, Sea-Based X-Band, THAAD, and Aegis BMD to support developmental test data collection.
  - Aegis BMD participated in the Fast Eagle Increment 1 HWIL exercise in June 2012, during which ballistic missile defense capabilities were explored using laboratory assets for Aegis BMD (3.6.1), AN/TPY-2 (FBM), C2BMC, SBIRS/DSP, and Patriot, with U.S. military operators manning the systems. These tests were designed to evaluate the capability of the AN/TPY-2 (FBM) and U.S. Central Command (USCENTCOM) C2BMC to augment the existing USCENTCOM BMDS capability.
  - The FTI-01 System Pre-Mission Test (SPMT) in July 2012 explored integrated engagement capability for Aegis BMD, THAAD, and Patriot in an operationally relevant architecture using HWIL assets. Aegis BMD 3.6.1 demonstrated simultaneous ship self-defense and ballistic missile defense as part of the test.
  - Fast Eagle Increment 1 Distributed in August 2012 assessed the capability of AN/TPY-2 (FBM) and C2BMC to augment a theater-regional defense architecture with Aegis BMD (3.6.1), THAAD, and Patriot fire units. U.S. military operators manned deployed tactical BMDS assets in the test.
  - Aegis BMD 3.6.1 participated in the Fast Eagle Increment 1+ HWIL exercise in September 2012. Laboratory representations of Aegis BMD, AN/TPY-2 (FBM), C2BMC, SBIRS/DSP, and Patriot explored ballistic missile defense capabilities in a theater regional environment. U.S. military operators manned the systems.

Assessment

- In FY12, Aegis BMD demonstrated the capability to perform end-to-end engagements against non-separating and simple separating short-range ballistic missiles with the Aegis BMD 4.0 system and SM-3 Block IB interceptors.
- In response to the anomalous behavior observed during the SM-3 Block IA flyout in FTM-15 (April 2011), the program redesigned a component in the third stage rocket motor, which is common to both the Block IA and Block IB interceptors. The newly redesigned component was flown in FTM-18 and performed successfully.
- The failed intercept in FTM-16 Event 2 (September 2011) is currently being addressed by the program. The program conducted three initial ground firing tests of the SM-3 third stage rocket motor to further understand the FTM-16 anomaly. Subsequently, the program conducted three ground firings of the third stage rocket motor to further verify that it functions properly using newly-adjusted firing parameters. Two more ground firings are planned before the end of the calendar year to close-out actions from the FTM-16 failure review board.
- GT-04 series ground tests in early FY12, which addressed EPAA Phase 1, showed that improvements in interoperability are needed between the various elements and sensors that are part of the EPAA Phase 1 defense architecture, including the Aegis BMD 3.6.1 system that continues to take part in these tests after completion of its FOT&E.
- The near-simultaneous engagement of an anti-air warfare target during FTI-01 verified ship self-defense capability while conducting a ballistic missile engagement even though the SM-3 Block IA interceptor missed its target. The MDA is investigating the cause of the missed intercept; however, their efforts will be hindered because Kill Weapon telemetry was lost during key portions of the engagement flyout.
- No LRS&T events are planned for Aegis BMD 4.0 until FTG-08. Aegis BMD has tested that capability only once during a flight test (FTG-06a in December 2010) and in ground testing to date. Further live-target testing of this capability is needed to allow for an assessment.

Recommendations

- Status of Previous Recommendations. The program partially addressed the single recommendation from FY11 when it conducted FTM-18 testing with the redesigned component in the SM-3 third stage rocket motor (to address the FTM-15 anomaly). Flight testing to demonstrate the correction for the FTM-16 Event 2 failure has not yet taken place.
- FY12 Recommendations. The program should:
  1. Conduct further live-target testing of the Aegis BMD 4.0.2 LRS&T capability using long-range targets to provide additional data on that capability for the Aegis BMD 4.0.2 system.
  2. Engage a medium-range target before the Full-Rate Production Decision for the SM-3 Block IB interceptor to support an assessment of midcourse defense capability.

Command, Control, Battle Management, and Communications (C2BMC) System

Executive Summary

- During FY12, Command, Control, Battle Management, and Communications (C2BMC) participated in three ground tests, three flight tests, exercise Fast Eagle Increment 1, and the Israeli Arrow Weapon System (AWS) Block 4 System Verification Flight Test.
- C2BMC Spiral 6.4 (S6.4) software demonstrated simultaneous live control of two AN/TPY-2 radars operating in Forward-Based Mode (FBM) in Turkey and Israel in support of the European Phased Adaptive Approach (EPAA) Phase 1 deployment.
- C2BMC demonstrated interoperability with Aegis Ballistic Missile Defense (BMD), Patriot, Terminal High-Altitude Area Defense (THAAD), the Space-Based Infrared System/Defense Support Program (SBIRS/DSP), and the AWS.
- The Missile Defense Agency (MDA) included the Global Engagement Manager (GEM) in the deployment of C2BMC S6.4 to the Combatant Commands. GEM provides greater automation of sensor management functions and improved track processing and reporting.
- Even with the deployment of GEM, C2BMC still has battle management capabilities limited primarily to situational awareness, radar track forwarding, and control of AN/TPY-2 (FBM) radars until at least FY17 when the MDA tentatively plans to field S8.2.

System

- C2BMC is a Combatant Command's interface to the fully integrated Ballistic Missile Defense System (BMDS).
- More than 70 C2BMC workstations are fielded at U.S. Strategic, Northern, European, Pacific, and Central Commands (USSTRATCOM, USNORTHCOM, USEUCOM, USPACOM, and USCENTCOM); numerous Army Air and Missile Defense Commands; Air and Space Operations Centers; and other supporting warfighter organizations. The current C2BMC system provides situational awareness to Combatant Commands and the National Command Authority with information on missile events, BMDS status, and system coverage. C2BMC also provides upper echelon deliberate planning at the Combatant Command and component level, permitting a federation of planners across the BMDS. BMDS elements (Aegis BMD, Ground-based Midcourse Defense [GMD], Patriot, and THAAD) use their own command, control, battle management systems and mission planning tools for stand alone engagements.
- C2BMC S6.4 provides command and control for multiple AN/TPY-2 (FBM) radars in the same area of responsibility. S6.4 includes the deployment of GEM, which includes updated sensor management, track processing, and reporting.

- C2BMC provides track forwarding of AN/TPY-2 (FBM) and AN/SPY-1 tracks to GMD. Additionally, it provides track forwarding of AN/TPY-2 (FBM) tracks for THAAD and Patriot cueing and Aegis BMD engagement support.
- C2BMC S8.2, although not fully defined by the MDA, is intended to improve and expand the initial S6.4 capabilities as the next step toward integrated sensor management. The MDA plans to field S8.2 not earlier than FY17.

Mission

U.S. Strategic, Northern, European, Central, and Pacific Commands currently use C2BMC to support ballistic missile defense engagements. Commanders use C2BMC specifically for:

- Deliberate and dynamic planning
- Situational awareness
- Track management
- AN/TPY-2 (FBM) sensor management and control
- Engagement monitoring
- Data exchange between C2BMC and BMDS elements
- Network management

Major Contractor

Lockheed Martin Information Systems and Global Solutions – Gaithersburg, Maryland

Activity

- The MDA conducted testing during FY12 in accordance with the DOT&E-approved Integrated Master Test Plan.
- The USEUCOM C2BMC upgrade to S6.4 was completed at the end of 2011 as part of the EPAA Phase 1 deployment. The USCENTCOM C2BMC upgrade to S6.4 will complete with the MDA publication of a Technical Capability Declaration in 4QFY12. Apart from already existing C2BMC roles in providing situational awareness, sensor management for acquisition, basic track forwarding, and some planning capability, S6.4 introduced the GEM suite at USPACOM (with a backup at Missile Defense Integration and Operations Center), USEUCOM, and USCENTCOM. C2BMC participated in the Flight Test THAAD-12 (FTT-12) IOT&E in October 2011, demonstrating interoperability with THAAD over Tactical Datalink 16. C2BMC provided situational awareness and status of the BMDS under test.
- The MDA conducted Ground Test Integrated-04d (GTI-04d) Part 2 in October 2011. The USEUCOM warfighters used C2BMC to control two AN/TPY-2 (FBM) radars. C2BMC also provided situational awareness and demonstrated interoperability with Aegis BMD, Patriot, Israeli AWS, and SBIRS/DSP.
- The MDA completed GTI-04 (Israel) in November 2011. C2BMC controlled one AN/TPY-2 (FBM) radar and demonstrated interoperability with Aegis BMD, Patriot, THAAD, SBIRS/DSP, and the Israeli AWS.
- In December 2011, C2BMC participated in Ground Test Distributed-04d (GTD-04d) Part 2. An AN/TPY-2 (FBM) radar was represented in the test architecture and controlled by C2BMC. Aegis BMD and SBIRS/DSP also participated.
- In December 2011, the MDA conducted GTD-04d Part 3 in support of the EPAA Phase 1 assessment. The USEUCOM sensor managers used C2BMC to command and control two AN/TPY-2 (FBM) radars for the first time in a distributed ground test. C2BMC demonstrated interoperability with Aegis BMD and SBIRS/DSP.
- In April 2012, the MDA conducted a developmental ground test, Ground Test Focused-04e (GTX-04e), and collected data for several C2BMC critical factors (referred to as Critical Engagement Conditions). C2BMC demonstrated interoperability with the full BMDS architecture, provided situational awareness, and controlled AN/TPY-2 (FBM) radars in USPACOM and USEUCOM areas of responsibility (one and two radars, respectively).
- C2BMC participated in the Fast Eagle Increment 1 hardware-in-the-loop test in June 2012 and distributed test in August 2012. It demonstrated the ability to provide situational awareness and command and control of one AN/TPY-2 (FBM) radar, and interoperability with other USCENTCOM BMD assets.
- In October 2012, C2BMC managed a deployed AN/TPY-2 (FBM) radar from which it forwarded acquisition cues to Aegis BMD and THAAD during the MDA's combined developmental/operational Flight Test Integrated – 01 (FTI-01).

Assessment

- GEM allows for automated management of multiple AN/TPY-2 (FBM) sensors located in one area of responsibility. It also provides greater automation of sensor management functions and improved track processing and reporting while requiring less operator involvement as compared to S6.2 software.
- C2BMC has limited battle management capabilities allowing Combatant Command sensor managers to direct AN/TPY-2 (FBM) radars to execute focused search plans or respond to a precision cue. S6.4 demonstrated command and control of a single AN/TPY-2 (FBM) radar in ground and flight tests. S6.4 demonstrated command and control of two AN/TPY-2 (FBM) radars in both a hardware-in-a-loop and distributed test environment, but not in a flight test using deployed assets.
- During the GTX-04e event, in which the MDA tested S6.4 interactions with strategic elements, C2BMC S6.4 demonstrated interoperability with strategic BMDS elements and the ability to provide situational awareness.
- The MDA tested C2BMC S6.4 interactions with theater elements throughout the GT-04 and Fast Eagle Increment 1 ground test campaigns in FY11 and FY12. In addition to providing situational awareness, C2BMC S6.4 demonstrated interoperability with theater BMDS elements and command and control of one and two AN/TPY-2 (FBM) radars contributing to the defensive capability for the southeastern European, Israeli, and Middle Eastern theaters.
- During the GT-04 and Fast Eagle Increment 1 campaigns, the MDA identified S6.4 interoperability and command and control deficiencies that affected track processing, situational awareness, and battle management. The MDA is currently testing solutions to these deficiencies. Some interoperability issues are outside of the C2BMC program's authority to resolve, and will require MDA and Service action.
- C2BMC appeared to successfully manage and forward cues from the deployed AN/TPY-2 (FBM) supporting FTI-01. Analysis is ongoing. DOT&E will report results in the 2012 BMDS report to Congress, scheduled for publication in February 2013.

Recommendations

- Status of Previous Recommendations. The MDA addressed eight of the previous nine recommendations. The MDA continues to make progress on the one outstanding FY06 recommendation to include assessments of Information Assurance during BMDS-centric C2BMC testing.
- FY12 Recommendation.
    1. The MDA should continue to address the C2BMC interoperability and command and control deficiencies uncovered during the GT-04 campaign. Resolution of these deficiencies should be demonstrated through ground and/or flight testing.

Ground-Based Midcourse Defense (GMD)

Executive Summary

- Capability Enhancement II (CE-II) kill vehicle problems limited advancement of the Ground-based Midcourse Defense (GMD) flight test program. No flight tests were conducted during FY12.
- The Missile Defense Agency (MDA) did make progress on GMD return-to-intercept by conducting a ground test campaign consisting of 11 electrical and mechanical tests designed to further characterize CE-II kill vehicle component capability and performance. The MDA has scheduled a two-flight test series in FY13 designed to confirm fixes to the CE-II kill vehicle.

System

GMD is a Ballistic Missile Defense System (BMDS) element that counters intermediate-range and intercontinental ballistic missile threats to the U.S. Homeland. The GMD BMDS includes:

- Cobra Dane Upgrade Radar at Eareckson Air Station (Shemya Island), Alaska
- Upgraded Early Warning Radars (UEWR) at Beale AFB, California; Royal Air Force (RAF) Fylingdales, United Kingdom; and Thule Air Base, Greenland
- Ground-based Interceptor (GBI) missiles at Fort Greely, Alaska, and Vandenberg AFB, California
- GMD ground system including GMD Fire Control (GFC) nodes at Schriever AFB, Colorado, and Fort Greely, Alaska; Command Launch Equipment (CLE) at Vandenberg AFB, California, and Fort Greely, Alaska; and In-Flight Interceptor Communication System Data Terminals (IDTs) at Vandenberg AFB, California, Fort Greely, Alaska, and Shemya Island, Alaska
- GMD secure data and voice communication system including long-haul communications using the Defense Satellite Communication System (DSCS), commercial satellite communications, and fiber optic cable (both terrestrial and submarine)
- External interfaces that connect to Aegis Ballistic Missile Defense (BMD); North American Aerospace Defense – U.S. Northern Command (NORAD-NORTHCOM) Command Center (N2C2) and Command, Control, Battle Management, and Communications (C2BMC) at Peterson AFB, Colorado; Space Based Infrared System/Defense Support Program (SBIRS/DSP) at Buckley AFB, Colorado; and AN/TPY-2 (Forward-Based Mode [FBM]) radar at Shariki Air Base, Japan
- Sea-Based X-Band (SBX) radar, which is a sea-based mobile sensor platform primarily for use as a test asset, but can be operationally deployed as needed

Mission

Military operators for the U.S. Army Space and Missile Defense Command/Army Forces Strategic Command (the Army service component to U.S. Strategic Command) will use the GMD system to defend the U.S. Homeland against intermediate-range and intercontinental ballistic missile attacks using its weapon, the GBI, to defeat threat missiles during the midcourse segment of flight.

Major Contractors

- The Boeing Company, Integrated Defense Systems, Missile Defense Systems – Huntsville, Alabama
- Orbital Sciences Corporation – Chandler, Arizona
- Raytheon Missile Systems – Tucson, Arizona
- Northrop Grumman Information Systems – Huntsville, Alabama

Activity

- The MDA conducted a GMD return-to-intercept ground test campaign (G-52-L) during 2QFY12. It consisted of 11 individual electrical and mechanical tests designed to further characterize CE-II kill vehicle component capability and performance.
- The MDA used hardware and software representations of the GFC IDTs and GBIs in the Ground Test Focused-04e (GTX-04e) in May 2012. The MDA conducted the GMD portion of the test to demonstrate functionality, interoperability, and performance of the GFC software version 6B2.1.

Assessment

- The MDA made progress on GMD return-to-intercept. It redesigned and tested Exo-atmospheric Kill Vehicle (EKV) components and established more stringent component and manufacturing process requirements. Analysis and ground test results indicate the previous mission failure root causes have been identified and fixed, but a demonstration flight test is required to validate that conclusion.
  - The MDA has scheduled a two-flight test series designed to validate these fixes. The GMD Control Test Vehicle-01 (GM CTV-01) has been scheduled for 2QFY13 as an interceptor-only diagnostic flight test to further characterize kill vehicle behavior in a representative flight environment. The Flight Test GMD-06b (FTG-06b) has been scheduled for 3QFY13 as a repeat of the FTG-06a flight test.
  - These current test windows represent the latest in a series of incremental slips over FY12. At the beginning of FY12, GM CTV-01 was scheduled to be flown in the middle of 3QFY12 and FTG-06b was scheduled for the middle of 4QFY12. Major causes of the slips were additional analysis time needed by the Failure Review Board, developmental issues with new inertial measurement unit firmware and isolation cradle hardware, and component manufacturing and quality concerns.
- GTX-04e demonstrated the capability to provide dynamic positioning updates to the GMD IDT onboard the SBX radar platform; the MDA had previously demonstrated this capability for the IDT at Fort Greely, Alaska, and Vandenberg AFB, California. Further, the MDA confirmed the transmission and data flow of a new message set from the AN/TPY-2 (FBM) radar to the new GFC software via the C2BMC.

Recommendations

- Status of Previous Recommendations. The MDA has started but not completed the FY11 recommendation to repeat the FTG-06a mission to verify root causes, Failure Review Board results, and permanent fixes for the deficiencies found during the flight test. They have identified root cause issues, implemented solutions, and scheduled a two-flight test series in FY13 designed to demonstrate GMD return-to-intercept. The FY07 recommendation to re-examine the GMD-specific lethality simulation needs has been transferred to the BMDS system-level assessment since it applies to all elements.
- FY12 Recommendations. None.

Terminal High-Altitude Area Defense (THAAD)

Executive Summary

- The Terminal High-Altitude Area Defense (THAAD) system intercepted two short-range targets nearly simultaneously in October 2011. The program completed this multiple simultaneous intercept as part of an IOT&E, which included a full battle sequence from planning through intercept under operationally realistic conditions. DOT&E concluded that the IOT&E demonstrated THAAD is operationally effective, operationally suitable, and survivable against the threats and in the environments tested.
- The THAAD system successfully intercepted a medium-range ballistic missile target for the first time in October 2012.
- All planned THAAD Build 1.0 capabilities have not yet been demonstrated. The most significant example is that the performance of the system using the radar advanced algorithm against a complex target has not been scheduled for test until FY14. The algorithm has been implemented in the operational software, but THAAD flight test profiles prior to FY14 are not expected to trigger demonstration of it.
- Redesign and retesting of a number of components are required to address all of the Army materiel release conditions imposed before full materiel release can be granted. In particular, many reliability improvements are required to meet Army requirements with confidence.

System

- The THAAD ballistic missile defense system consists of five major components:
  - Missiles
  - Launchers
  - Radars (designated AN/TPY-2 (TM) for Terminal Mode)
  - THAAD Fire Control and Communications (TFCC)
  - Unique THAAD support equipment
- THAAD can accept target cues for acquisition from the Aegis Ballistic Missile Defense (BMD), satellites, and other external theater sensors and command and control systems.
- THAAD is intended to complement the lower-tier Patriot system and the upper-tier Aegis BMD system.

Mission

U.S. Strategic Command intends to deploy and employ THAAD, a rapid response weapon system, to protect critical assets worldwide. Commanders will use the THAAD kill vehicle to intercept an incoming threat ballistic missile in the endo-atmosphere or exo-atmosphere, limiting the effects of weapons of mass destruction on battlefield troops and civilian populations.

Major Contractors

- Lockheed Martin Missile and Fire Control – Dallas, Texas
- Lockheed Martin Space Systems Company – Sunnyvale, California
- Raytheon Integrated Defense Systems – Tewksbury, Massachusetts

Activity

- Flight Test THAAD Interceptor-12 (FTT-12) IOT&E occurred in October 2011. The test was a multiple simultaneous engagement of two short-range targets. This test supported materiel release of the first two THAAD batteries and future Beyond Low-Rate Initial Production decisions. The THAAD battery performed battle planning, overseas deployment, emplacement, and mission operations under operationally realistic conditions within the constraints of test range safety. The THAAD battery also conducted additional simulated intercept events against a raid, defeating threats generated by the Simulation Over Live Driver (SOLD).
- The combined developmental/operational Flight Test Integrated-01 (FTI-01) in October 2012 included a THAAD engagement against a medium-range target for the first time. The test evaluated interoperability between THAAD; Aegis BMD; Patriot; Command, Control, Battle Management, and

Communications (C2BMC); and AN/TPY-2 Forward-Based Mode (FBM) elements with multiple live targets.
- Ground Test Integrated-04 Israel (GTI-04 ISR) in November 2011, Ground Test Other-04e (GTX-04e) in April 2012, Fast Eagle Increment 1 Hardware-In-The-Loop (HWIL) in June 2012, and GTI-04e in November 2012 included laboratory HWIL representations of THAAD. Interoperability, engagement coordination between the theater elements, and engagement capabilities against short- and medium-range ballistic missiles were tested using BMDS configurations that are deployed or nearing deployment.
- The MDA conducted testing during FY12 in accordance with the DOT&E-approved Integrated Master Test Plan.

Assessment
- The THAAD and AN/TPY-2 Radar systems performed a successful engagement of two targets during the FTT-12 test. The classified DOT&E February 2012 THAAD and AN/TPY-2 Radar Operational and Live Fire Test and Evaluation Report concluded the following:
  - THAAD is operationally effective against short-range ballistic missile threats of the types tested to date. It has not been demonstrated against medium-range threats. However, empirical data from short-range flight testing, ground testing, and analyses indicate THAAD likely has capability against medium-range threat missiles.
  - THAAD is operationally suitable. Nevertheless, examination of reliability data, ground test results, challenges encountered during testing, and Soldier feedback indicate that THAAD has suitability-related limitations. Adequate availability and maintainability were demonstrated, but testing identified maintenance shortfalls. Different failure modes were seen in two tests creating uncertainty in the Mean Time Between System Abort. Improvements are also needed in deployability, manpower and training, human factors engineering, and interoperability.
  - THAAD is survivable in chemical, biological, radiological, and external electromagnetic environments. It has not been tested in electronic warfare environments.
- Conditional Materiel Release of the first two THAAD batteries in February 2012 included 39 conditions that need to be resolved before a full materiel release could be granted. The THAAD Project Office and the Army have begun to address these conditions including verification testing of the thermally initiated venting system on the interceptor, electrical stress testing of the optical block in the interceptor flight sequencing assembly, and validation and verification demonstrations of changes and updates to the technical manuals. Four conditions (equipment grounding, air load certification, spares transport shelter, and the Surface Deployment and Distribution Command-Transportation Engineering Agency transportability certification) have been closed. Analyses of data collected during the FTI-01 test are ongoing, which potentially will close eight additional conditions. Fixes and testing of remaining conditions are scheduled through 2017.
- Initial assessment from the FTI-01 test mission data indicated that the THAAD system successfully intercepted a medium-range ballistic missile target. The interoperability assessment between THAAD and other elements based on FTI-01 test data is ongoing.
- Ground tests utilizing HWIL representations of THAAD demonstrated interoperability and engagement coordination between THAAD and other theater elements revealing problems that need to be addressed for multi-element coordination.

Recommendations
- Status of Previous Recommendations. The MDA has satisfactorily addressed all previous THAAD recommendations.
- FY12 Recommendations. The MDA and the Army have begun to address the 22 THAAD recommendations contained in the classified DOT&E February 2012 THAAD and AN/TPY-2 Radar Operational and Live Fire Test and Evaluation Report. Fifteen of the recommendations align directly with the Army materiel release conditions, which are being addressed through a corrective action plan agreed to by the THAAD Project Office and the Army. Of the remaining seven recommendations, three are classified (Effectiveness #2, Effectiveness #5, and Survivability #4). The four remaining unclassified recommendations are:
  1. The MDA and the Army should reassess the required spares and tools (including their quantities) that should be on site with the battery based on all available reliability and maintainability data (Suitability #5).
  2. The MDA and the Army should define duties related to THAAD at the brigade level. Until a battalion is established for THAAD, it should also define duties and training for THAAD battery personnel on any required battalion-level duties (Suitability #10).
  3. The MDA and the Army should implement equipment redesigns and modifications identified during natural environment testing to prevent problems seen in testing (Suitability #11).
  4. The MDA and the Army should conduct electronic warfare testing and analysis (Survivability #3).

Sensors

Executive Summary

- Ballistic Missile Defense System (BMDS) sensors participated in five ground tests, three flight tests, and exercise Fast Eagle Increment 1 testing during the reporting period.
- Although the Missile Defense Agency (MDA) placed the Sea-Based X-band (SBX) radar into a limited test support and standby operational status, the MDA continued to include it in ground tests when appropriate.
- Accreditation of each of the sensor models for use in performance assessments continues to progress but is incomplete.
- The BMDS Operational Test Agency Team will be unable to accredit the Cobra Dane radar model until after the MDA completes a 3QFY15 flight test involving the radar.

System

The BMDS sensors are systems that provide real-time ballistic missile threat data to the BMDS. The data are used to counter ballistic missile attacks. These sensor systems are operated by the Army, Navy, Air Force, and the MDA, and include a satellite-based, infrared sensor system and five phased array radar system types. The sensor systems are:

- Space Based Infrared System/Defense Support Program (SBIRS/DSP), a satellite constellation of infrared sensors operated by the Air Force with an external interface to the BMDS located at Buckley AFB, Colorado


SBIRS/DSP

- Fixed site, fixed orientation, phased array radars
  - Cobra Dane Upgrade (CDU) Radar, an L-band radar (one radar face that provides 120-degree azimuth field of view) operated by the Air Force and located at Eareckson Air Station (Shemya Island), Alaska


Cobra Dane

  - Upgraded Early Warning Radars (UEWRs), ultra high frequency radars operated by the Air Force and located at Beale AFB, California (two radar faces that provide 240-degree azimuth field of view); Fylingdales, United Kingdom (three radar faces that provide 360-degree azimuth field of view); and Thule, Greenland (two radar faces that provide 240-degree azimuth field of view). [The MDA and Air Force Space Command awarded a contract in July 2012 for the upgrade of the Early Warning Radar (EWR) at Clear Air Force Station, Alaska. The contract also included an option for the upgrade of the EWR at Cape Cod Air Force Station, Massachusetts.]


UEWR

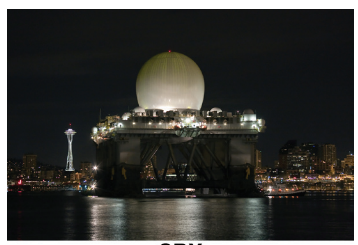
- Mobile platform, variable orientation, phased array radars
  - AN/TPY-2 (Forward-Based Mode [FBM]) Radars, X-band radars (one radar face that provides 120-degree azimuth field of view) operated by the Army and located at Shariki Air Base, Japan, and sites in Israel and Turkey


AN/TPY-2

  - Aegis Ballistic Missile Defense (Aegis BMD) AN/SPY-1 Long-Range Search and Track (LRS&T) Radars, S-band radars (four radar faces that provide 360-degree azimuth field of view) operated by the Navy and located aboard Aegis BMD-capable cruisers and destroyers


Aegis BMD

  - Sea-Based X-Band (SBX) Radar, an X-band radar operated by BMDS and located aboard a twin hulled, semi-submersible, self propelled, ocean going platform (primarily a test asset that can be operationally deployed as needed)


SBX

Mission

Military operators for the U.S. Strategic Command, U.S. Northern Command, U.S. European Command, U.S. Pacific Command, and U.S. Central Command will use the BMDS sensors to:

- Detect, track, and classify ballistic missile threats that target the United States, U.S. allies, and U.S. friends
- Provide data for situational awareness and battle management to the BMDS Command, Control, Battle Management, and Communications (C2BMC)
- Provide data that support engagement of ballistic missile threats by ballistic missile defense systems

Major Contractors

Aegis AN/SPY-1
- Lockheed Martin – Moorestown, New Jersey

AN/TPY-2
- Raytheon Company, Integrated Defense Systems – Woburn, Massachusetts

CDU
- Raytheon Company, Integrated Defense Systems – Woburn, Massachusetts

SBIRS
- Lockheed Martin Space Systems Company – Sunnyvale, California

SBX
- Raytheon Company, Integrated Defense Systems – Woburn, Massachusetts

UEWRs/EWRs
- Thule, Beale, and Fylingdales
  - Exelis – Colorado Springs, Colorado
- Clear and Cape Cod
  - Raytheon Company, Integrated Defense Systems – Woburn, Massachusetts

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Activity
- The MDA conducted testing during FY12 in accordance with the DOT&E-approved Integrated Master Test Plan.
- The MDA used an AN/TPY-2 (FBM) radar, SBX radar, Cobra Dane radar, and the UEWRs at Beale, Fylingdales, and Thule in a BMDS-level satellite test campaign. Using these radars, the MDA tracked selected satellites to collect data that the MDA and the BMDS Operational Test Agency Team use to verify, validate, and accredit the radar models and simulations used to assess BMDS performance.

Aegis BMD Radar
- The MDA used a hardware-in-the-loop (HWIL) representation of the Aegis BMD radar in its long-range surveillance and track mode in Ground Test Focused-04e (GTX-04e) in April 2012.

AN/TPY-2 (FBM) Radar
- The AN/TPY-2 (FBM) radar participated in Flight Test Integrated-01 (FTI-01) in October 2012. In FTI-01, the AN/TPY-2 (FBM) radar provided up-range track data to C2BMC for processing, down-select, and forwarding of tracks to Aegis BMD, Patriot, and Terminal High-Altitude Area Defense (THAAD).
- In 1QFY12, deployed AN/TPY-2 (FBM) radars participated in Ground Tests Distributed (GTDs) to demonstrate Phase 1 European Phased Adaptive Approach (EPAA) capability:
  - GTD-04d (Part 2) provided the data required for a Technical Capability Declaration of the EPAA Phase 1 radar.
  - GTD-04d (Part 3) completed the EPAA Phase 1 Capability demonstration including C2BMC control of multiple deployed AN/TPY-2 radars.
- The AN/TPY-2 (FBM) radar participated in the BMDS-level distributed ground test Fast Eagle Increment 1 in August 2012. The MDA used this testing to evaluate the capability of the AN/TPY-2 (FBM) radar and the associated C2BMC to augment existing Combatant Command BMDS capability.
- The MDA used an HWIL representation of the AN / TPY-2 (FBM) radar in these BMDS-level ground tests: Ground Test Integrated-04d (GTI-04d) Part 2 (October 2011), GTI-04 (Israel [ISR]) (November 2011), GTX-04e (April 2012), and Fast Eagle Increment 1 (June 2012 and September 2012).
- AN/TPY-2 (FBM) radars participated in BMDS Integrated Sensor Demonstration – Space Situational Awareness (BISD-SSA), a Joint Chiefs of Staff sponsored test with C2BMC and Air Force Space Command. This test demonstrated the ability of AN/TPY-2 (FBM) radars to acquire and track space objects. The Joint Space Operations Center (JSPOC) sent tasking messages to C2BMC, which converted the messages into radar task commands that the radars executed. Data were collected and sent to JSPOC in real time, which then published the data for authorized user access.

Cobra Dane Radar
- HWIL representations of the Cobra Dane radar participated in the BMDS-level ground test GTX-04e in April 2012.
- In FY12, the Air Force used the Cobra Dane radar to observe targets of opportunity. The U.S. Space Command also used the Cobra Dane radar as a contributory sensor to the Space Surveillance Network to track orbital debris and active satellites.

SBIRS/DSP System
- During FY12, the Air Force used the SBIRS/DSP system to observe domestic and foreign launch events, provide launch event data to the operational BMDS, and participate in the intercept flight tests: Flight Test Standard Missile-3-16 (FTM-16) Event 2a, FTM-18, and FTI-01.
- A digital representation of the SBIRS/DSP system participated in the BMDS-level ground tests: GTI-04d Part 2 (October 2011), GTI-04 (ISR) (November 2011), GTX-04e (April 2012), and Fast Eagle Increment 1 (August 2012).

SBX Radar
- An HWIL representation of the SBX radar participated in the BMDS-level ground test GTX-04e in April 2012.
- Both an HWIL and digital representations (simulations) of the SBX radar participated in pre-mission testing for the upcoming Ground-based Midcourse Defense (GMD)

intercept Flight Test Ground-based Interceptor-06B (FTG-06b).
- The MDA utilized Glory Trip-203, a Minuteman III intercontinental ballistic missile test, to demonstrate the ability of SBX to exercise software build 2.2.1.2.5 in a live track mission, collecting advanced discrimination algorithm data for future use, verifying algorithms, and supporting analysis/risk reduction for upcoming tests, such as FTG-06b.
- The MDA placed SBX in a limited test support status. The SBX can be reactivated based on warning of a threat presented to the United States, and for BMDS flight testing.

UEWR/EWR – Beale, Thule, Fylingdales, Clear, and Cape Cod
- HWIL representations of the UEWRs at Beale, Fylingdales, and Thule participated in the BMDS-level ground test GTX-04e in April 2012.
- In FY12, the U.S. Air Force used the Beale, Fylingdales, and Thule UEWRs, and Clear and Cape Cod EWRs, to observe targets of opportunity. U.S. Space Command also used these radars as collateral sensors to the Space Surveillance Network to track orbital debris and active satellites.

Assessment
- The MDA has gained significant operational experience with each of the BMDS sensors since the completion of sensor upgrade and development programs.
- The MDA and the BMDS Operational Test Agency Team, however, have not fully accredited models and simulations of the BMDS sensors for performance assessment. Representations of the AN/TPY-2 (FBM) radar, the SBX radar, and the UEWR have been accredited for limited uses. Representations of the Aegis BMD radar, the Cobra Dane radar, and the SBIRS/DSP system have not been accredited. The MDA is analyzing the radar performance data that were collected in the FY12 satellite tracking campaign for its use toward accreditation of multiple radar models and simulations.
- Starting in FY13, the U.S. Air Force will have the responsibility for the sustainment of the Cobra Dane radar and the UEWRs. The U.S. Air Force does not currently gather all of the operational data required for assessing suitability.

Aegis BMD Radar
- In GTX-04e, and in prior ground tests, the MDA demonstrated a capability of the Aegis BMD radar (in its LRS&T mode) to support GMD engagement of intermediate-range and intercontinental ballistic missile threats.
- The Aegis BMD radar provided data that enabled the GMD system to generate sensor cueing and missile engagement plans. However, a quantitative assessment of the Aegis BMD radar LRS&T mode performance was not possible since the MDA used some models and simulations (including the intermediate-range and intercontinental ballistic missile threat models) that were not accredited for performance assessment.
- The MDA has not conducted a BMDS intercept flight test that uses the Aegis BMD LRS&T radar data in real-time as the primary data source for GMD engagement planning. The MDA currently plans to conduct this test during 3QFY14.

AN/TPY-2 (FBM) Radar
- In FTI-01, the MDA demonstrated AN/TPY-2 (FBM) radar capability to provide up-range track data to C2BMC to support engagement of a medium-range ballistic missile by THAAD.
- In the BMDS-level ground tests, the MDA demonstrated AN/TPY-2 (FBM) radar capability to provide real-time track data that supported BMDS situational awareness, BMDS sensor tasking, and GMD engagement planning. However, a quantitative assessment of the AN/TPY-2 (FBM) radar performance was not possible since the MDA used some models and simulations (including the intermediate-range and intercontinental ballistic missile threat models) that were not accredited for performance assessment.

Cobra Dane Radar
- In GTX-04e, the MDA demonstrated interoperability of the Cobra Dane radar with a new version of the GMD Fire Control software. In addition, the MDA demonstrated a capability of the Cobra Dane radar to provide real-time data that enabled the GMD system to generate missile engagement plans and supported GMD system engagement of intermediate-range and intercontinental ballistic missile threats. A quantitative assessment of the Cobra Dane radar performance was not possible since the MDA used some models and simulations (including the intercontinental ballistic missile threat models) that were not accredited for performance assessment.
- Due to its location and field of view, the Cobra Dane radar has not participated in BMDS intercept flight tests. The MDA plans to conduct a target flight test through the Cobra Dane radar field of view in 3QFY15 to support model and simulation accreditation.

SBIRS/DSP System
- SBIRS/DSP system performance and its capability to support BMDS engagement of intermediate-range and intercontinental ballistic missile threats will be provided in the classified appendix of DOT&E's "2012 Assessment of the Ballistic Missile Defense System (BMDS)" report to Congress.

SBX Radar
- In GTX-04e, the MDA demonstrated interoperability of the SBX radar with a new version of the GMD Fire Control software.
- The MDA has demonstrated a capability of the SBX radar to support GMD engagement planning against an intermediate-range ballistic missile target. However, the MDA has not gathered adequate SBX radar performance data against intermediate-range and intercontinental

ballistic missile threats and targets to enable accreditation of the SBX radar models and simulations that are required for performance assessment.

UEWR/EWR – Beale, Thule, Fylingdales, Clear, and Cape Cod

- Due to their locations and fields of view, the UEWRs at Beale, Thule, and Fylingdales have not participated in BMDS intercept flight tests in an operationally realistic manner. Data from targets of opportunity and ground tests support performance estimates for the current configuration of the UEWRs. These estimates rely on models and simulations that have not been fully accredited for use in performance assessment.
- The MDA and the Air Force have not yet upgraded the EWRs at Clear and Cape Cod Air Force Stations, and these radars are not yet part of the MDA's sensor network.

Recommendations

- Status of Previous Recommendations. The MDA has satisfactorily addressed all but two of the previous sensor recommendations. Although the MDA and Combatant Commanders have made progress on developing concepts of operations for the sensors, this FY09 recommendation remains open pending completion of those concepts and implementation in operational testing. Additionally, while the MDA has specified the Aegis BMD LRS&T radar as the primary data source for GMD engagement planning in an intercept flight test attempt in 3QFY14, this FY11 recommendation remains open pending successful execution of that test.
- FY12 Recommendations. The DOT&E February 2012 THAAD and AN/TPY-2 Radar Operational and LFT&E Report made three recommendations for the MDA and Army to consider for AN/TPY-2(FBM). One of the recommendations aligns directly with the Army materiel release conditions, which are being addressed through a plan agreed upon by the Sensors Product Office and the Army. The following two recommendations from the report remain open.
  1. Perform additional flight testing with multiple AN/TPY-2 (FBM) radars in a single Area of Regard or theater to assess C2BMC's ability to correctly task and coordinate track data from multiple radars.
  2. Conduct independent, dedicated AN/TPY-2 (FBM) Information Assurance testing.

Live Fire Test and Evaluation

Live Fire Test and Evaluation

Live Fire Test and Evaluation (LFT&E) Program

DOT&E executed oversight of survivability and lethality test and evaluation for 122 acquisition programs in FY12. Of those 122 programs, 19 operated under the waiver provision of U.S. Code, Title 10, Section 2366, by executing an approved alternate LFT&E strategy in lieu of full-up system-level testing. In addition, Section 2366 also requires DOT&E to report on a program's LFT&E results prior to that program entering into full-rate production.

DOT&E published reports on the following programs during the past year (reports marked with an asterisk were sent to Congress):

LFT&E Reports

- Enhanced Combat Helmet*
- Family of Medium Tactical Vehicles (FMTV) A1P2*
- Stryker Double-V Hull (DVH) Configuration of the Commander's Vehicle (CVV)

Special Reports Regarding LFT&E

- Active Protection Systems (APS)*
- Hellfire Romeo Missile
- Mine Resistant Ambush Protected (MRAP) – All-Terrain Vehicle (M-ATV) Underbody Improvement Kit (UIK)
- Stryker Mobile Gun System (MGS) Engineering Change Order (ECO) Block 3
- BAE-Tactical Vehicle System (TVS) Caiman Mine Resistant Ambush Protected (MRAP) Vehicle.

Combined OT&E/LFT&E Beyond Low-Rate Initial Production Reports

- AH-64D Apache Block III (AB3) Attack Helicopter*
- Mine Resistant Ambush Protected (MRAP) Family of Vehicles: Dash with Independent Suspension System (ISS), MRAP Recovery Vehicle (MRV), Marine Corps Cougar Ambulance*
- Spider XM7 Network Command Munition*
- Stryker Nuclear, Biological, and Chemical Reconnaissance Vehicle (NBCRV)*
- Terminal High-Altitude Area Defense (THAAD) and AN/TPY-12 Radar*

Combined OT&E/LFT&E Assessments

- Family of Medium Tactical Vehicles (FMTV)
- MH-60S Airborne Mine Countermeasures Helicopter and AN/ASQ-20A Mine Detecting Sonar
- Mine Resistant Ambush Protected (MRAP) Family of Vehicles: Navistar Dash Ambulance and MRAP All-Terrain Vehicle (M-ATV) Underbody Improvement Kit (UIK)
- Stryker Double-V Hull (DVH) Configuration of the Engineer Squad Vehicle (ESVV)
- Stryker Double-V Hull (DVH) Configuration of the Scout Vehicle (ICVV)
- Stryker Double-V Hull (DVH) Configuration of the Mortar Carrier Vehicle (MCVV)
- Stryker Double-V Hull (DVH) Configuration of the Medical Evacuation Vehicle (MEVV)

In addition to satisfying acquisition oversight requirements, the LFT&E program funds and executes technical oversight on investment programs that provide joint munitions effectiveness data (Joint Technical Coordinating Group for Munitions Effectiveness). The LFT&E program also develops advanced technologies and analytical methods to increase aircraft survivability (Joint Aircraft Survivability Program), and conducts vulnerability and lethality testing of fielded platforms and weapons systems and improves survivability analysis tools (Joint Live Fire Program). LFT&E investment programs also support quick reaction efforts addressing urgent operational commander's needs.

JOINT TECHNICAL COORDINATING GROUP FOR MUNITIONS EFFECTIVENESS (JTCG/ME)

The Joint Logistics Commanders chartered the Joint Technical Coordinating Group for Munitions Effectiveness (JTCG/ME) in 1968 to ensure development of consistent and credible effectiveness estimates for conventional munitions across the DoD. DOT&E oversees the JTCG/ME and provides funding. The JTCG/ME produces and distributes these data in Joint Munitions Effectiveness Manuals (JMEMs). The primary application supported is weaponeering, the detailed technical planning of a weapon strike that occurs at multiple levels in the operational chain of command before actual combat. JMEMs provide computerized tools and data for rapid evaluation of alternative weapons and their delivery against specific targets. In many cases, JMEMs generate collateral damage estimates as a part of the decision criteria for strikes approved at the highest levels of the U.S. Government.

In FY12, the JTCG/ME published two updated JMEMs and a set of Collateral Effects Radii (CER) tables. The JMEM Weaponeering System (JWS) v2.1 software and the JTCG/ME-generated Chairman of the Joint Chiefs of Staff Instruction 3160.01 CER tables are used for operational weaponeering and collateral damage estimates directly supporting operations in the U.S. Africa Command and U.S. Central Command Areas of Responsibility. To provide continued support to operational commanders, as well as DoD targeting and mission planners, the JTCG/ME also developed and incorporated geometric models representative of various targets for use in assessing the effectiveness of weapons. JTCG/ME released the second updated JMEM, JTCG/ME's air-to-air and surface-to-air planning model, the Joint Anti-Air Combat Effectiveness System (J-ACE) v5.1, in July 2012, which includes the data required to assess the survivability of strike aircraft.

Operational Weaponeering

JWS is the joint source for air-to-surface and surface-to-surface weaponeering, munitions, and target information. JWS evaluates the effectiveness of a multitude of munition-target combinations for numerous air-to-surface and surface-to-surface munitions against a variety of target types in real-time. JWS v2.1 contains the Fast Integrated Structural Tool (FIST). FIST is the JMEM operational-level tool that allows weaponeers to quickly develop geometric models of soft and hardened targets and use those models to evaluate weapons effects. In particular, the tool can then generate weapon effectiveness and damage assessments for infrastructure targets including buildings, bunkers, and tunnels. JWS v2.1 contains approximately 180 new or updated targets, 15 new and updated munitions, new Explosive Equivalent Weights based on blast testing, and an improved 3-D viewer for displaying target models.

Operational Mission Planning

JTCG/ME released J-ACE v5.1 to support operational mission planning, particularly at U.S. Strategic Command (USSTRATCOM). J-ACE simulates U.S. and threat air-to-air and surface-to-air engagements, providing flyout models for U.S. and threat air-to-air and surface-to-air missiles, as well as probability of kill estimates. Previous releases generated pre-computed probability of kill tables given an intercept for selected weapon-target pairings and engagement conditions. Because use of these tables proved tedious, J-ACE v5.1 now provides new Endgame Manager v2.2.0 software and data sets, which allow on-demand calculation of multiple kill levels for specific engagement conditions encountered at intercept. To more effectively support operational mission planning, J-ACE v5.1 also provides a direct interface to force-level simulations. These simulations are used to study tactics, evaluate training, assess the relative performance of missiles, and plan scenarios.

Collateral Damage Estimation

The JTCG/ME supported development and fielding of the Digital Precision Strike Suite Collateral Damage Estimation tool for operational use. This tool displays accredited Collateral Damage Estimate Level effective radii reference tables. Additionally, JTCG/ME personnel trained nearly 250 users at 10 different commands to support collateral damage estimation decisions.

Information Operations

In conjunction with the Air Force Targeting Center, the JTCG/ME assessed fielded and emerging applications for conducting information operations as part of early efforts to develop a capability within JMEM to evaluate the effects of such operations. These efforts included the development of an initial set of simple tools for assessing the effects of selected applications when used to conduct Computer Network Attack, Computer Network Defense, Military Information Support Operations, and Electronic Warfare.

JOINT AIRCRAFT SURVIVABILITY PROGRAM (JASP)

DOT&E sponsors and funds the Joint Aircraft Survivability Program (JASP), which develops techniques and technology to improve the survivability of U.S. military aircraft. The Naval Air Systems Command, Army Aviation and Missile Command, and Air Force Aeronautical Systems Center charter the program. DOT&E establishes objectives and priorities for the JASP and exercises oversight of the program. Working with joint and Service staffs, other government agencies, and industry, the JASP promotes the adoption throughout the Military Services of the most current techniques and technologies for improving aircraft survivability.

The JASP is supporting the Joint Multi-Role (JMR) Technology Capabilities Demonstration (TCD) as a member of the Platform Integrated Product Team. The purpose of the JMR TCD is to demonstrate transformational vertical lift technologies to prepare the DoD to develop the next generation of vertical lift aircraft. JASP was instrumental in establishing assumptions and requirements for the vulnerability analysis used in evaluating the initial three government model prototypes.

The JASP funded 59 development projects ($10.2 Million) and delivered 41 final reports in FY12. The following examples illustrate current JASP efforts in four focus areas: susceptibility reduction, vulnerability reduction, survivability assessment, and combat damage assessment.

Susceptibility Reduction

These efforts addressed urgent aircraft survivability needs emerging from Operation Enduring Freedom, as well as improved aircraft survivability against future threats.

Countermeasure Requirements against New Infrared Seekers.

The JASP, in conjunction with the Naval Research Laboratory (NRL), is performing in-depth analyses of newly obtained threat infrared seekers to develop flare and jammer infrared countermeasures (IRCM). The first objective is to identify anomalous behavior seen when certain countermeasures are used against one particular threat. The second objective is to evaluate the effectiveness of current countermeasure technologies, tactics, and techniques when employed against these seekers. The third objective is to develop new tactics and techniques to improve countermeasure performance if the current methods are not sufficient in defeating the seekers. Initial results focused on developing new countermeasure solutions for one threat system.

Advanced Techniques for Radio Frequency Countermeasures (RFCM).

In partnership with the U.S. Air Force Special Operations Command, the JASP is developing and testing RFCM technology and techniques to increase aircraft survivability and situational awareness for Army, Navy, and Air Force special operations rotary- and fixed-wing aircraft. This project assesses the ability of onboard systems to receive, process, and display each operating mode of the threat weapon system; develops RFCM techniques; and demonstrates their effectiveness against state-of-the-art threat radar weapons. Validated threat identification and countermeasure techniques for surface-to-air missile and airborne radar systems are being developed for incorporation in the AN/ALQ-211 Suite of Integrated Radio Frequency Countermeasures on the CV-22, MH-47, and MH-60, and in the AN/ALR-69 radar warning receivers on the C-130.

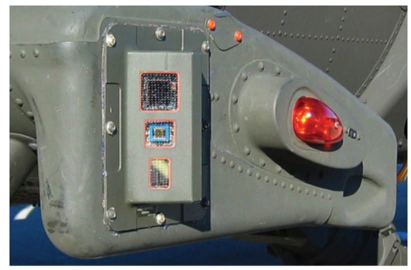
Omniscient Electronic Attack.

In partnership with NRL, the JASP is demonstrating the use of a Digital Radio Frequency Memory jammer that adapts in real-time to the received radar waveform, rather than identifying the threat / radar mode and selecting electronic attack techniques from a pre-programmed database. The intent is to overcome limitations of pre-programmed response-based electronic attack techniques against advanced, multi-mode, coherent radar threats. If successful, this technique could be implemented on EA-18G Growler aircraft as well as other electronic attack platforms.

ShotSense 3-D Aircraft Hostile Fire Indication (HFI) System.

The JASP and the U.S. Army Communication-Electronics Research Development and Engineering Center supported development of a high performance; low cost, size, weight, and power; uncooled infrared threat detection system for the tracking and classification of small arms, rocket-propelled grenades (RPGs), missiles, and other hostile fires. The initial focus was on ground testing in natural and urban high-clutter environments. Tests demonstrated the ability to detect and classify threats and cue radars for projectile tracking during a Live Fire Demonstration. The DoD and the United Kingdom Ministry of Defence are considering using the system for HFI/Counter-Rocket, Artillery and Mortar applications at forward operating bases. The DoD is also considering the system for use on the U.S. Special Operations Command Little Bird helicopter to provide that small aircraft with hostile fire and missile warning capabilities.

Hostile Fire Indication (HFI) Threat System Geolocation.

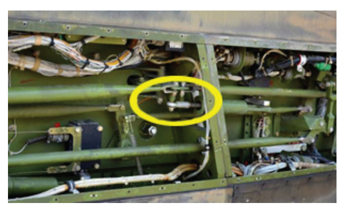


In partnership with the U.S. Army Aviation Applied Technology Directorate, the JASP is developing and testing software algorithms for incorporation in the AN/AVR-2B(V) Laser Warning System enabling the system to perform precise geo-location of hostile fire threats. The algorithms will be applicable to all aircraft using the AN/AVR-2B(V), such as the Apache and Black Hawk helicopters.

Vulnerability Reduction

Several agencies undertook efforts to develop lighter-weight opaque and transparent ballistic protection systems, fuel containment and related fire protection technologies, and tolerant structures and materials, including self-healing composites.

Critical Component Protection.

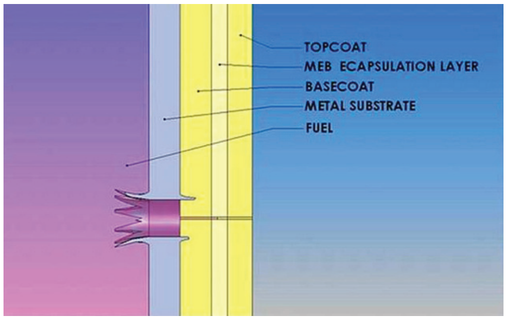


AH-1Z Flight Control Bell Crank

AH-1Z Complex Shape Armor Installation

The U.S. Army Aviation Applied Technology Directorate led a project to manufacture complex, curved ceramic armor for placement at strategic locations on aircraft, improving survivability with minimal weight impact. These installations protect flight-critical aircraft components that when damaged would lead to catastrophic aircraft loss. Due to their complexity, these structurally integrated panels required development of several cutting-edge material and processing technologies. Two implementations were demonstrated: the OH-58D Kiowa Warrior engine bay door and the AH-1Z Cobra helicopter flight control linkage bell-crank. The exposed bell-crank is a point of vulnerability in the flight control system. The complex (multiple curvatures in multiple directions) panel provides ballistic protection. Both implementations successfully increased protection with little or no weight increase and are being evaluated for transition to the fleet.

Self-Healing Fuel Cell Membrane.
The Naval Air Warfare Center Weapons Division led development of a new self-sealing coating technology. The coating is designed to mitigate leaks from composite structures containing fluid (e.g., wet wings or fuel compartments) when subjected to a ballistic impact. The goal is to seal the fuel cell to a damp seal within two minutes at ambient temperature at a reduced weight compared to current self-sealing fuel bladders. The solution must be suitable for retrofit on fielded aircraft or installation on new aircraft and must work equally well with new alternative fuels. Following successful initial testing, the Air Force selected this solution as a component of the vulnerability reduction design for the future KC-46 tanker aircraft.



Thermal Degradation of Composites.

This project examined the degradation of aircraft structural composite materials due to heat damage caused by short-lived fuel fires. After calibration through mechanical test, evaluations were made of various non-destructive inspection (NDI) methods and their ability to detect incipient thermal degradation. The results of the testing were transitioned to Fleet Readiness Centers for the generation of inspection and repair procedures. The success of this project also led to a U.S.-Germany bilateral research agreement and a new project to validate fire and heat exposure damage data on representative composites used extensively on the F-35. The new effort will also validate the ability of portable NDI techniques to detect equivalent measures of thermal degradation.

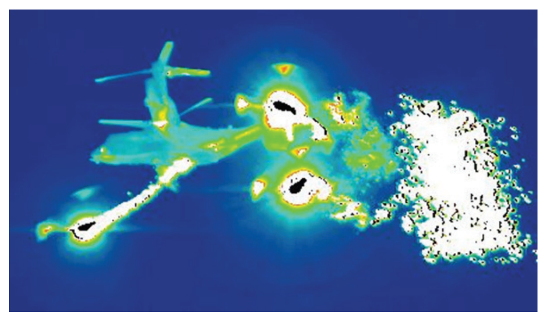
Survivability Assessment

The projects in this area develop and maintain components of models and simulations that are widely used to support weapon system acquisition (e.g., design studies, specification development, and specification compliance) and test and evaluation (e.g., test design, evaluation, and assessment).

Suite of Anti-Air Kill Chain – Models and Data (SAK-MD).
The JASP, the JTCG/ME, and USSTRATCOM have been working for several years to improve the methods and data employed by USSTRATCOM to plan global strike missions. Initial efforts developed a new methodology to efficiently and consistently assess probability of kill for a large set of blue aircraft and red threat pairs. More recently, the team has concentrated on adding the effects of radio frequency and infrared countermeasures into the methodology and data sets. By coupling widely accepted countermeasure-capable engagement models with fast running operational user-focused models, the team has developed a new benchmark capability for performing aircraft-threat engagement analyses. SAK-MD has been widely distributed as part of the JTCG/ME J-ACE product and, in addition to USSTRATCOM, is used extensively by Air Force, Navy, and Marine Corps aircrews in weapon systems training.

Crew and Passenger Survivability (CAPS).
The JASP continued to advance the development of analysis, data, test capability, and technology for improving aircraft CAPS. This year concluded the initial effort to develop an analytical framework for CAPS evaluation by demonstrating the inclusion of CAPS in two commonly used vulnerability analysis models. The effort also included drafting a report on the state of crew casualty evaluation methodologies and a roadmap for future methodology development. The project will continue to improve CAPS assessment methodologies, test capabilities, and technologies working in partnership with the National Aeronautics and Space Administration, Federal Aviation Administration, and U.S. Army Tank Automotive Research, Development and Engineering Center.

Infrared Countermeasure (IRCM) Modeling.
The JASP continued data collection and model development to improve the DoD's IRCM analysis capability against advanced multi-spectral and imaging infrared threats. Current infrared engagement simulations rely on simple flare models that lack the resolution required to address advanced infrared missile seekers. The JASP and Naval Surface Warfare Center – Crane Division are developing physics-based models for pyrotechnic and pyrophoric flares that address combustion, heat and mass transfer, infrared radiation, trajectory, and spatial extent/image presentation; ultimately providing the time evolution of plume or cloud characteristics necessary for analysis of the effectiveness of countermeasures against missiles using advanced infrared seekers. The project is also modernizing the joint modeling and simulation tools, Flare Aerodynamic Modeling Environment, and the Tri-Service Flare Database to improve usability, add 3-D descriptions of air flowing around aircraft, and develop Linux versions of both tools.



V-22 Dispensing Flares Clouds

Combat Damage Assessment

JASP continued to support the Joint Combat Assessment Team (JCAT) in FY12. JCAT comprises Army, Air Force, Navy, and Marine Corps personnel deployed in support of combat operations. JCAT continued its operation in Afghanistan with full-time deployments in Regional Commands – South, Southwest, and East. Iraq and other areas of the world were supported remotely or by rapid deployment from Afghanistan or stateside.

JCAT inspects damaged and destroyed aircraft, acquires maintenance records, and conducts interviews with aircrew and intelligence personnel to develop an accurate and comprehensive assessment of each aircraft combat damage event. They provide consultation to weapons, tactics, and logistics personnel and comprehensive briefings to commanders in charge of daily air operations. These efforts allow battlefield commanders to adjust operational tactics, techniques, and procedures based on accurate threat and damage assessments. As of November 22, 2012, the JCAT had initiated 221 and completed 179 FY12 aircraft combat damage assessments.

The JCAT improved aircraft combat damage incident reporting in the Services and the DoD. The Combat Damage Incident Reporting System (CDIRS) hosted by the Survivability/Vulnerability Information Analysis Center (SURVIAC) is the repository for all U.S. aircraft combat damage reports. The JCAT worked closely with SURVIAC to upgrade the CDIRS database, its data reduction capability, and links to the JCAT knowledge centers. JCAT and SURVIAC are also working with OSD and U.S. Central Command (USCENTCOM) on an operational demonstration linking both CDIRS and USCENTCOM databases to more quickly identify, assess, document, and distribute aircraft combat damage incident data to the Services and DoD.

The JCAT trains the U.S. aviation community on potential aircraft threats and combat damage, including representatives from the U.S. Military Services, the Department of State, the Department of Homeland Security, the Federal Aviation Administration, the Department of Energy, the Federal Bureau of Investigation, and the Bureau of Alcohol, Tobacco, Firearms and Explosives.

JOINT LIVE FIRE (JLF)

The goal of the Joint Live Fire (JLF) program is to test fielded systems, identify vulnerable areas, understand damage mechanisms, and provide the information needed to make design changes; modify tactics, techniques, and procedures; or improve analytical tools. The need for these tests result from systems being exposed to new threats, being used in new, unanticipated ways, or being operated in new combat environments, thereby requiring an updated assessment of their performance.

JLF supplements LFT&E of systems by testing new threats that the requirements community did not anticipate during original development or old threats employed in new ways. The RPG is an example of a threat employed differently than initially intended. Originally developed as an anti-tank or anti-personnel weapon, hostile forces in Afghanistan often use the RPG as an anti-helicopter weapon.

Aircraft Systems Program

JLF-Air completed nine test series in FY12, with a focus on resolving key modeling and testing deficiencies highlighted in the 2010 Man-Portable Air Defense Systems (MANPADS) Vulnerability Capabilities Roadmap, providing threat characterization data for high-explosive incendiary and armor piercing projectiles, and investigating occupant survivability deficiencies resulting from ballistic events. The JLF program has made significant progress over the last three years in understanding MANPADS threat characteristics and developing a viable test capability for use in LFT&E.

Large Engine Vulnerability to MANPADS.
This project is assessing the ballistic vulnerability of a large turbofan engine to a MANPADS missile impacting from the rear, and using that information to explore subsequent flying qualities of large aircraft. Live fire testing using realistic engagement conditions were achieved by using shotlines representative of real-world encounters, operating the engine at typical thrust levels, simulating the proper amount of external airflow across and through the engine, and accurately controlling the MANPADS missile impact location, velocity, and detonation point.

The project provided test results to the National Aeronautics Space Administration enabling it to conduct flight simulations to determine the flying qualities that can be expected during cruise and landing as a result of the damage witnessed in the test. The project will present simulation results, along with test observations, in a final report to be completed in early 2013.

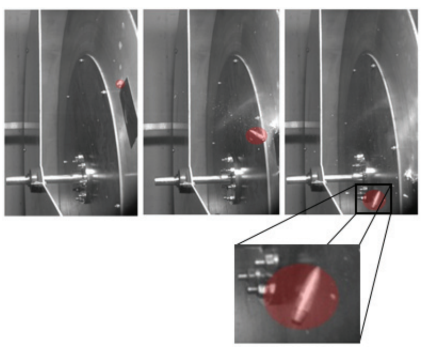
MANPADS Threat Model Development – Fragment and Debris.
This project concluded testing for the MANPADS Threat Model Development test series. This test series was designed to gather data with sufficient quality to improve the accuracy and credibility of MANPADS threat models used to assess and predict aircraft vulnerability. This test collected warhead fragment and debris for two MANPADS that were flown and detonated in the center of a specially instrumented test arena.

Supersonic Rocket on a Rope.
This project is developing a capability to support testing of various platforms' vulnerability to MANPADS missiles. Using this technique, the missile is flown along a set of ropes, acting as guide wires, which are cut just before reaching the intended target. Once cut free, the missile is allowed to free-fly into the target achieving a high-level of precision in hitting

pre-determined impact points. Prior year tests satisfactorily demonstrated high precision hits. This year's tests also included detonating the MANPADS missile warhead using a range-safe fuze. In 2013, the project will be in its final year and is expected to culminate in a demonstration with three shots using actual MANPADS tactical fuzes, rather than range fuzes, for warhead detonation.

Threat Projectile Characterization.
Several JLF-Air projects focused on collecting threat characterization data for small arms or Anti-Aircraft Artillery (AAA) threats. One such project filled deficiencies in data on the performance of certain fuzes used in 14.5 mm and 23 mm high-explosive incendiary projectiles. A gap in understanding the ballistic performance multiple variations of 7.62 mm and .30-caliber armor piercing/armor piercing incendiary projectiles similarly resulted in a test series to determine the appropriate round for use in experimental ballistic testing.

V_{50} Yaw of Projectiles.
This project is exploring how a projectile, such as those impacting fast moving targets, penetrates typical aircraft materials when impacting the materials at other than normal (i.e., 90 degrees) incidence. Test results will provide immediate feedback on the accuracy of the analytical vulnerability tools now being commonly used and will be used to update the Computation of Vulnerable Area Tool and the Advanced Joint Effectiveness Model. The test concept was successfully demonstrated in 2012 and 40 test events at varying speeds, effectively creating different yaw angles, are underway.



Rotorcraft Sponson RPG Vulnerability.
This project evaluated three technologies for suppressing cabin fires resulting from RPG impacts to sponson fuel tanks adjacent to aircraft cabins. Although large main cabin fires occurred in this testing, the testing demonstrated that some of these technologies are effective in either mitigating or eliminating the resulting fire. This testing focused on cabin environment and occupant survivability. Data from cabin thermocouples, pressure transducers, and mannequins were collected to establish occupant effects. These data, along with an evaluation of the fire suppression technologies tested, will be published in FY13.

Crew Compartment Fire Survivability.
This project characterized the environment of an aircraft main cabin during fires representative of those seen as a result of ballistic events. Baseline testing focused on cabin conditions with no airflow (i.e., all hatches, doors, and windows closed) and the effectiveness of personal fire extinguishers to extinguish those fires. Using a specially modified H-3 helicopter fuselage developed under this project, data were collected using a comprehensive instrumentation package gathering multiple temperature, oxygen and carbon monoxide levels, and visibility measurements. For each test event, the cause and time to reach an incapacitation threshold were determined.

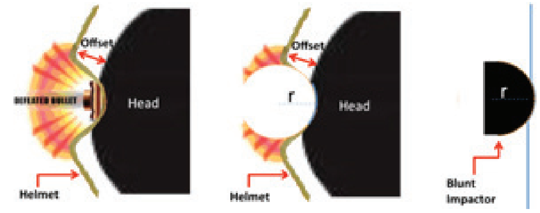
Ground Systems Programs

Roadmap to Address Hybrid-III Mannequin Sustainment.
This project investigated modification and improvement options for the currently utilized Hybrid-III Anthropomorphic Test Device (ATD). The Hybrid-III ATD is the primary instrument for gathering accelerative injury data from live fire underbody blast testing. This project identified several low cost technical upgrades that will help sustain the Hybrid-III ATD through 2018, at which point the live fire community expects to transition to the Warrior Injury Assessment Manikin (WIAMan) ATD, currently under development.

Test and Analysis to Update Warhead Characterization for MK 82 Bomb.
This project conducted a series of five MK 82 general purpose bomb tests to characterize fragment size, speed, and direction. Tests were conducted utilizing the JTCG/ME standard procedures, with fragments collected in recovery bundles and impact speeds measured utilizing electronic triggering panels. The JTCG/ME Systems Characterization Working Group is reviewing the results, which, when accepted, will be utilized for weapon lethality, collateral damage, and risk assessments. This testing was in direct response to requests from operational Commanders employing the MK 82.

Testing to Gather Penetration for Low-Collateral Damage Round.
This project conducted a series of tests with low-collateral damage rounds against plate arrays typical of a light ground mobile target to obtain residual properties of the projectiles (i.e., speed, weight, and orientation after penetration through different materials). Information collected will be utilized to improve the JTCG/ME predictive Projectile Penetration (ProjPen) model. ProjPen is utilized to predict penetrator performance against ground mobile, rotary- and fixed-wing aircraft, and small watercraft. ProjPen currently lacks predictive capability for this type of round and data did not exist to implement that capability.

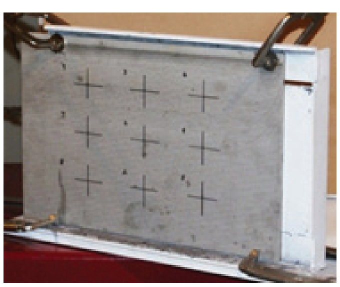
Behind Helmet Blunt Trauma Skull Injury.
This JLF project is part of a series of experiments to improve the testing and evaluation of military combat helmets. Blunt-ballistic impact tests will be used to develop an injury criterion or risk for behind-helmet blunt trauma, where currently none exist. JLF can



use the injury criterion to assess the severity of loading, as well as the risk of sustaining injury, with potential to implement this criterion into future testing and evaluation of new protective equipment.

Improvements to Sustained Fire Prediction in Vulnerability/Lethality Analysis Methodologies. This project assessed the ability of lethality and vulnerability (L/V) models to predict sustained fire as a kill mechanism for ground mobile targets. Analysis of available test data indicates current L/V fire start methodologies under-predict sustained fire resulting from near-field detonations of blast-frag warheads. This initial assessment of fire start predictive capability will compile available relevant test data and reports, assess the current L/V fire start models in light of their underlying empirical data, and propose a way forward for improving the capability of L/V codes to predict sustained fire as a kill mechanism.

Continued Improvement of Material Characterization for ProjPen Modeling.



This project is conducting tests to gather data for small caliber armor piercing incendiary projectiles striking stainless steel plates. Testing is focused on penetration velocities and the gathering of residual masses and velocities of penetrating fragments. This will improve the quality of L/V analyses involving ProjPen. Both the JTCG/ME and JASP utilize ProjPen for the analysis of the damaging effects of small caliber projectiles.

Effects of Buried Homemade Explosive (HME) Performance Variability on Platform and Occupant Survivability. This project is quantifying the potential variations in the buried blast performance of materials manufactured to represent a typical Homemade Explosive (HME). Similar to many HMEs, the material is a blend of different materials and is granular in nature. The characteristics being investigated arise from the processes required to manufacture the material. Multiple blends at extreme tolerances of acceptable variances in mixtures are being tested in controlled blast experiments. The results of the tests will be used to establish models for the performance of the material. For effects identified as significant (i.e., greater than standard shot-to-shot variability) the explosive models will be used with a full system model to establish the effect on ballistic effects delivered to a vehicle such as those that may be observed during a live fire test.

Sea Systems Program

The Joint Live Fire Sea Systems Program (JLF-Sea) made significant progress in FY12 towards improving the capability to assess the survivability of submarines and surface ships. These projects benefit ship and submarine acquisition programs as well as the fleet of fielded U.S. Navy vessels.

Finnish Fast Attack Craft Testing. FY12 was the last year of a multiyear, trilateral (United States, Finland, and Germany) cooperative effort to perform damage testing against two aluminum, decommissioned Finnish fast attack craft. The Finnish Navy provided the ships and has conducted testing on their test range in the Baltic Sea and at their test center in Niinisalo, Finland. The objective was to understand the behavior of aluminum structures subjected to various weapon effects. In FY12, shaped charge testing against a section of one of the ships was conducted to study spall and debris from aluminum targets, to perform crew casualty assessments, and to evaluate depth-of-penetration. These tests will fill gaps in our understanding of weapon effects against aluminum ships, and will augment the LFT&E programs for the Littoral Combat Ship and Joint High Speed Vessel.

Vulnerability of Aluminum Structure to Fire.

This project conducted tests to determine if fire insulation and its attachment could be defeated by a major fire. A test article representative of a section of a USS *Independence* class Littoral Combat Ship flight deck was built using specified materials and insulation attachment materials and procedures. The article was then exposed to tests similar to those specified by military standard (MIL STD 3020). Results from this project will fill gaps in our understanding of the vulnerabilities of aluminum structures and their insulation systems to weapon-induced fires.

Crew Casualty Modeling and Simulation Validation Testing.

The objective of this project, jointly funded by the Office of Naval Research and JLF, is to validate injury response functions developed under an earlier JLF project. Three Hybrid-III ATDs were tested on a floating shock platform to collect data on personnel injuries caused by an underwater explosion. The data and observations from this testing will improve the accuracy of crew casualty predictions made as a part of ship live fire vulnerability assessments.

Network Fire Model Enhancements. This project provided funds to continue development of the NRL network fire model. The model can be used by naval engineers to develop ship designs that limit the spread of fire and smoke. NRL began a two-year effort to improve the model's capability to predict fire characteristics associated with large volume spaces such as hangar and mission bays.

Sea Bottom Underwater Explosion Effects Testing. This project, the result of an agreement between the U.S. and German Navies, continues development and validation of simulation tools for assessing ship survivability to various explosive threats. JLF provided funding to conduct underwater explosion testing representing charges located on and near the sea floor to quantify the loading on vessels submerged near the bottom, submerged between the surface and the bottom, and floating at keel depth. This project provides data to increase the fidelity of models, increase the accuracy of survivability assessments, and to address urgent operational needs.

LFT&E SPECIAL INTEREST PROGRAMS

Active Protection Systems (APS)

In response to FY08 legislation, DOT&E tested and evaluated seven foreign and domestic (two foreign, three domestic, and two combined foreign/domestic) APS with the potential to protect wheeled tactical vehicles from RPGs. DOT&E provided a report to Congress and the Department's acquisition leadership in February 2012. This effort concluded that none of the tested APS are currently mature enough for fielding on any U.S. platform and further development, test, and evaluation are required.

Personnel Protection Equipment

DOT&E continued its oversight of the testing of personnel protection equipment. The Services and Special Operations Command (USSOCOM) continue to implement rigorous, statistically-based testing protocols for hard body armor inserts and military combat helmets approved by DOT&E. The Defense Logistics Agency has utilized the hard armor testing protocol in new contracts for sustainment stocks of hard armor inserts. The Army has incorporated the key concepts of statistical confidence and test design into its requirements for its Soldier Protection System. The Navy and Air Force are also implementing statistical testing concepts for soft armor vests.

DOT&E, in partnership with the Services and USSOCOM, is developing a new soft armor vest testing protocol. That protocol is intended to standardize testing and assure that soft armor vests provided to Service members meet common ballistic protection requirements and provide uniform protection on the battlefield. The implementation of this protocol will further increase government oversight of personal protective equipment by requiring soft armor vests (in addition to hard armor plates and combat helmets) to meet rigorous statistical measures of performance.

The National Academy of Sciences' (NAS) Committee to Review the Testing of Body Armor Materials for Use by the U.S. Army published its final report in May 2012. This report completes the NAS' three-phase review of body armor testing that began in 2009 following the release of a critical 2009 U.S. Government Accountability Office report of testing conducted at the Army's Aberdeen Test Center. The final NAS report reviewed a number of topics, including the use of statistically principled testing, measurement standards, and body armor test methodology. The report concluded that the hard body armor test protocol is statistically principled and provides an acceptable minimum DoD-wide body armor test standard. The report notes the need for additional work in the areas of both measurement improvement and characterizing variance in the performance of the clay backing material used during testing to further improve test quality. The Army is currently testing a new clay formulation that, if successful, would eliminate the drawbacks of the clay currently used and described in the NAS report. The report also makes several recommendations for research and investigation into the medical effects of blunt force trauma, and for applying the results of this research to improve body armor test procedures. Both DOT&E and the Army are working to use the results of ongoing medical research into blunt trauma to update body armor test methodologies and procedures. DOT&E has asked the NAS to review and comment on the Department's statistically-based combat helmet test protocol, a 15-month study that is expected to be complete by the end of 2013.

Stryker Double-V Hull (DVH)

The Army initiated the Stryker Double-V Hull (DVH) program in response to Operation Enduring Freedom commanders' requests for improved underbody blast threat protection. Under DOT&E oversight, the Army incrementally developed and tested multiple Stryker DVH configurations over a two-year timeframe. The test and evaluation program directly supported critical fielding schedules, and DOT&E reported to the USD(AT&L) and Army leadership on each Stryker DVH configuration's survivability, effectiveness, and suitability prior to its fielding. Test and evaluation confirmed that DVH configurations significantly improve crew protection against IEDs and demonstrated the retention or improvement of required operational characteristics. Relative to flat-bottom Strykers, Stryker DVH remained equally mobile and capable of supporting a unit's ability to accomplish a mission, while providing improved reliability and maintainability. The results of the test and evaluation program also led to design changes that corrected significant shortcomings in DVH suitability and survivability.

Underbody Blast Testing

DOT&E continues to actively pursue efforts to improve LFT&E employing underbody blast threats. In January 2011, the DoD provided funds to the Army to execute a DOT&E-sponsored five-year research and development program. This program will substantially increase the Department's understanding of the cause and nature of injuries incurred in underbody blast combat events and will develop new instrumentation capable of being used to accurately assess such injuries in testing. This program, known as WIAMan (Warrior Injury Assessment Manikin), utilizes expertise across multiple commands and disciplines within the Army to generate a medical research plan from which data will, at pre-determined times, be transitioned to the materiel and test and evaluation communities. These data will feed the design of a biofidelic prototype ATD designed to accurately capture occupant loading from the vertical direction, reflecting the primary load axis to which occupants are exposed in an under-vehicle blast event.

Similarly, as a result of DOT&E efforts, the Army will characterize the performance of a surrogate for the Afghanistan IED threat to enable its use in test, the performance of buried TNT blast threats (current test standard), and the effects of soil composition and condition on full-scale buried test threats. This effort will ensure adequate LFT&E in support of OEF as well as of future acquisition programs.

Information Assurance and Interoperability

Information Assurance and Interoperability

Information Assurance (IA) and Interoperability (IOP)

In FY12, the DOT&E Information Assurance (IA) and Interoperability (IOP) Assessment Program performed 20 assessments during Combatant Command (CCMD) and Service-level exercises or real-world activities; 3 of these assessments involved units deployed to the U.S. Central Command (USCENTCOM) area of responsibility. The IA / IOP program conducted reduced-scale assessments at U.S. European Command (USEUCOM) and U.S. Africa Command (USAFRICOM) after their scheduled exercises were cancelled in response to actual operational contingencies. Six individual test and evaluation organizations conducted these assessments, which involved all 10 of the CCMDs and all 4 Services. During the year, DOT&E released five major findings reports, and initiated another nine, pertaining to both IA and IOP. Exercise planners in FY12 made increased use of cyber ranges in support of these exercises.

Summary of Findings

Most exercise assessments and tests involved operations largely against low- and mid-level cyber threats and on networks that were only moderately stressed in terms of loading or network degradation; high-level threats were portrayed infrequently. No exercises were seriously disrupted by adversary activities, or disrupted at any length, because adversary teams were generally not permitted to take actions that could disrupt exercises. In the cases where the adversary team portrayed higher-level threats, exercise training audiences frequently misinterpreted these portrayals as maintenance issues, poor system performance, or anomalies.

Overall, the DOT&E IA/IOP program observed cyber effects caused by unresolved interoperability deficiencies, coupled with low-to-moderate level threats that were sufficient to adversely affect the quality and security of mission critical information in a way that could (and where permitted did) degrade mission accomplishment significantly. Therefore, considering both IA and IOP attributes, the Department has not yet developed sufficiently advanced cyber defensive tactics to counter advanced adversary tactics and to consistently operate in degraded cyber environments.

Interoperability: The FY12 IOP assessments documented interoperability problems involving mission critical systems, but these problems hindered rather than prevented mission accomplishment. This is due primarily to system operators who developed workarounds to preserve the critical mission functions. Even though operators accomplished their missions, the workarounds usually increased operator workload, and often degraded efficiency in completing mission tasks. The assessment teams documented effects on the timeliness, accuracy, and efficiency of operational data handling. Operators frequently viewed interoperability problems as maintenance or design issues and therefore did not report, document, or remediate many of these problems. The majority of systems encountered during assessments were not certified for interoperability.

Information Assurance: The overall IA performance observed during the FY12 exercise assessments remains insufficient to prevent and consistently detect compromise and exploitation of the networks exercised. Although regularly able to penetrate and exploit networks, Red Teams reported modest increases in the required level of effort over previous years. While compliance with network standards continues to improve, the IA/IOP program continued to provide low ratings for certain critical compliance areas. In addition, development of the more sophisticated tactics and procedures necessary to counter a determined or well-resourced cyber adversary remains slow. In exercises involving portrayal of more sophisticated threat profiles, the training audiences usually lacked commensurate defensive tactics. Overall, the implementation of Joint Staff guidance on exercise realism has been slow. Network boundary defenses continued to improve in FY12, to include the presence of host-based intrusion detection tools, improved configuration management of networks and security tools, and the infrastructure supporting the networks. In at least one exercise, good network "housekeeping" effectively deterred adversary efforts. However, DOT&E observed reduced rates of compliance in the use of software and hardware backups; and key practices such as port-and-protocol protections, reliable software baselines, remediation of known vulnerabilities, and effective use of system audit logs.

Partnerships and Coordination

DOT&E continued a number of partnerships directly related to the conduct of IA/IOP assessments. These included:

- Collaborating with the Joint Staff and DoD Deputy Chief Information Officer (CIO) concerning oversight and coordination of the IA and IOP Assessment Program. DOT&E provides metrics and observations generated from these assessments to the DoD CIO for use in enterprise-wide IA assessments and programs.
- Coordinating program efforts with USD(AT&L) and Developmental Test and Evaluation (DT&E) as a means of supporting the acquisition and development of information handling systems.
- Creating a standing memorandum of understanding between DOT&E and U.S. Cyber Command (USCYBERCOM) that directs the establishment and operation of the Cyber Assessment Synchronization Working Group (CASWG), as well as information exchange and collaboration in a variety of areas of interest. The CASWG is developing processes to synchronize planning, execution, and reporting among all cyber assessment activities, and especially those supporting exercise assessments.
- Sharing of information and expertise with the Joint Staff's Joint Deployable Analysis Team continues to enhance assessments.

The partnership collaborated to conduct two assessments in FY12, and further joint assessments are planned for FY13.

- Collaborating with the intelligence community, the National Security Agency, and the Service Information Warfare centers to improve the portrayal of the representative cyber threats during exercises. The Defense Intelligence Agency (DIA) made significant progress in defining advanced and emerging methods of cyber attack, and was instrumental in mapping known adversary activities to the threat portrayals for several FY12 exercises.
- Working with the Naval Postgraduate School to research and develop improved capabilities for network analyses. This partnership includes the design and development of network test tools; instrumentation; training resources and test/evaluation methods; analysis of compliance and performance findings to postulate cause/effect models for use in simulation; and mapping of direct operational effects arising from network performance issues.
- Coordinating with the Defense Information Systems Agency (DISA) to improve and expand the assistance and training available to assessed organizations, including the implementation of a cyber-defense training and assessment suite at several CCMDs.

FY12 ACTIVITIES

In FY12, the six assessing organizations were the Army Test and Evaluation Command; the Navy's Commander, Operational Test and Evaluation Force; the Marine Corps Operational Test and Evaluation Activity; the Joint Interoperability Test Command; the Air Force Operational Test and Evaluation Center; and the Air Force 688th Information Operations Wing. These 6 assessing organizations completed 20 exercises or site assessments under the IA and IOP Assessment Program, and 2 reduced scope assessments at sites where exercise activity was either curtailed or cancelled. These assessments included 13 CCMD and 6 Service exercise assessments (see Table 1). Three assessments involved units deployed in the USCENTCOM area of responsibility.

TABLE 1. INFORMATION ASSURANCE AND INTEROPERABILITY EXERCISE EVENTS IN FY12

EXERCISE AUTHORITY	EXERCISE	ASSESSMENT AGENCY
U.S. Africa Command	Judicious Response 2012 (Exercise Cancelled)	ATEC
U.S. Central Command	AOR Site Assessment #1	ATEC
	AOR Site Assessment #2	ATEC
	AOR Site Assessment #3	ATEC
U.S. Cyber Command	Cyber Flag 2012	ATEC
U.S. European Command	Austere Challenge (Exercise Cancelled)	ATEC
North American Aerospace Defense Command / U.S. Northern Command	Vigilant Shield 2012	688 IOW
	Ardent Sentry 2012	688 IOW & AFOTEC
	Vibrant Response 2012	JITC
U.S. Pacific Command	Terminal Fury 2012	COTF
U.S. Southern Command	PANAMAX 2012	ATEC
U.S. Special Operations Command	Emerald Warrior 2012	ATEC
U.S. Strategic Command	Global Lightning 2012	JITC
U.S. Transportation Command	Assessment During Operations	JITC
U.S. Forces Korea	Key Resolve 2012	ATEC
	Ulchi Freedom Guardian 2012	ATEC
U.S. Army	Full Scope Exercise 2012-4	ATEC
U.S. Navy	Bold Alligator 2012	COTF
U.S. Air Force	Angel Thunder 2012	JITC
	Red Flag 2012-3	688 IOW
U.S. Marine Corps	Ulchi Freedom Guardian 2012 (III MEF)	MCOTEA
	Bold Alligator 2012	MCOTEA

AOR – Area of Responsibility AFOTEC – Air Force Operational Test and Evaluation Center ATEC – Army Test and Evaluation Command
COTF – Commander, Operational Test and Evaluation Force IOW – Information Operations Wing JITC – Joint Interoperability Test Command
MCOTEA – Marine Corps Operational Test and Evaluation Activity MEF – Marine Expeditionary Force

Several developments in FY12 confirm increasing emphasis across the DoD to prepare to train and operate in a contested cyberspace environment. The Chairman, Joint Chiefs of Staff (CJCS) is preparing additional guidance to amplify the Execute Order (EXORD) issued in FY11 to increase realistic cyberspace conditions in training exercises. Threat portrayal improved during assessed training exercises but with limited progress made towards implementing EXORD requirements. The overall number of instances in which exercise commanders permitted cyber effects to disrupt operations increased, as did the number of sites where these effects were demonstrated; however, the overall effect remains low due to constraints imposed upon Red Teams.

The Defense Intelligence Agency (DIA) Cyber Threat Assessment (CTA) Office continued to make significant progress in defining advanced and emerging methods of cyber attack, and was instrumental in mapping known adversary activities to the threat portrayals for several FY12 exercises. For example, CTA threat assessments for U.S. Pacific Command's (USPACOM) Terminal Fury 2012 contributed to an integrated Red Team employing multiple attack vectors, an opposing force (OPFOR) with a cyber cell that controlled the Red Team and received exfiltrated information, and some of the most realistic cyber play observed to date in an exercise. CTA also has developed a method to assess the shortfalls between the postulated threat and the threat that was actually present in training, which will be a key metric for evaluating implementation of the CJCS EXORD.

To enhance the IA posture of acquisition programs, DOT&E continued to revise and refine the templates and process for assessing the adequacy of IA testing in acquisition Test and Evaluation Master Plans and test plans. These templates facilitate development and review of these documents to ensure that IA is adequately addressed. DOT&E applied the templates and new process to the Test and Evaluation Master Plans for 34 systems, the operational test plans of 13 systems, and related test documents of 8 systems. Additionally, DOT&E IA experts specifically observed IA tests and reviewed data for the following three systems after previously reviewing test documentation:

- Patriot Missile (PAC-3)
- U.S. Navy dry cargo ship (T-AKE)
- U.S. Army Apache Block III helicopter

FINDINGS, TRENDS, AND ANALYSIS

Interoperability

The FY12 assessments found that interoperability issues encountered by the exercise training audience largely hindered, but ultimately did not prevent mission accomplishment. This was primarily because operators developed and executed effective workarounds. The workarounds increased operator workload, and often degraded the efficiency of completing tasks, or degraded timeliness and accuracy of the information generated.

Operators frequently view interoperability problems within systems architectures as maintenance or design issues beyond the control of local authorities. Therefore, many of these problems are not reported, documented, or remediated. More often, local users will develop practices and techniques to work around the lack of a desired/designed automated function. Workarounds include such techniques as:

- Manual transcription of data from one system to another, introducing transcription errors
- Data transfer between systems via portable media, thereby opening both systems to outside malware intrusion
- System re-boot/re-set to trigger update routines, usually resulting in increased delay and latency of operational data

System-to-system interoperability problems remain largely unreported. Over the last two years, slightly less than one-quarter of all systems observed during exercise assessments had been fully certified for interoperability. Of those systems, only two-fifths have ever been previously certified, indicating that almost half of the exercise systems have lapsed in certification or been replaced by uncertified software versions. Configuration management and documentation of observed systems (certified or not) were reported by the system operators to the operational test observers as satisfactory for 9 of every 10 systems. Operators cited system reliability as a problem in almost one-third of all systems reviewed in FY12, an increase over previous years. Several of the findings either reported or under research by DOT&E involve interoperability shortfalls, including:

- AOC Interoperability – software baseline and interoperability certification in the Air and Space Operations Centers lacks centralized configuration management and control. As a result, the Air and Space Operations Centers do not have standard software, and frequently employ locally-produced middleware to accommodate system-to-system interoperation. Furthermore, the version of the Global Command and Control System (GCCS) in use at all of the AOCs had not been fully tested or certified for operational use. (Note: since the release of this finding, the testing and certification of the most recent update for GCCS-Joint is in progress, which includes AOC operational support.)
- Third Party Patching – DoD uses a large number of commercial software suites, ranging from the baseline Windows® Operating System on most desktop computers, Adobe file readers, JAVA script, and other commonly available commercial administrative and business software. DoD does not have a means of central management for updates to these commercial applications, requiring local network authorities to download commercial patches and updates, test, and implement them individually.
- Surveillance Radar Systems – A wide-area surveillance radar system observed during one exercise was found to potentially allow control of the sensor from multiple workstations/roles/accounts within the command and control software that accesses the radar – essentially preventing a stable configuration during operations.

Information Assurance

Red Teams reported increased difficulty in penetrating network defenses; however, results show that with sufficient time, Red Teams routinely penetrated networks and systems with few exceptions. Detection rates of network intrusions remained low, and the ability of network defenders to detect subsequent exploitations of information was minimal.

The CJCS EXORD of February 2011 to Incorporate Realistic Cyberspace Conditions into Major DoD Exercises directs more realistic cyber adversary portrayals in all major CCMD and Service-level exercises. There is little evidence that the milestones cited in the EXORD (such as identification of critical mission tasks and systems) have been completed.

The level of threats portrayed in assessed exercises in FY12 (see Figure 1) remained similar to previous years, with a modest increase in both high-level portrayals and exercises in which no threat was portrayed (usually onsite/non-exercise assessments without Red Teams). While exercise commanders permitted degraded network operations on almost twice as many unclassified network sites than the previous year, the instances of degraded performance on classified networks declined slightly. In FY12, a quarter of all Red Team activities were directly disruptive to networks assessed, a step forward in the implementation of the EXORD guidance. However, in cases where adversary teams portrayed higher-level threats, exercise training audiences were unable to either develop or demonstrate advanced mitigation or tactics in the face of these threats. As a result, the exercise participants' defensive actions were not well-matched to the threats portrayed, and sometimes exacerbated the negative effects of the cyber threat.

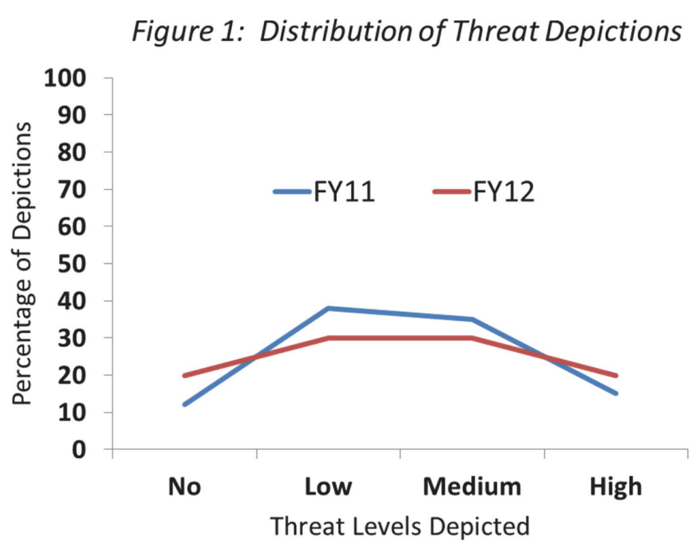


Figure 1: Distribution of threat portrayals in assessed exercises. The majority of threats portrayed in FY12 were low-to-medium capability, and occurred less often than in FY11. A modest increase in high-level threat portrayals was seen at a limited number of exercise sites.

Exercise personnel at times misinterpreted the cyber effects from these more aggressive and disruptive threat portrayals as arising from non-adversary causes such as maintenance shortfalls, system performance problems, or even as artificialities within the exercise construct. As a result, exercise participants either ignored or otherwise did not report significant network events, essentially denying network defenders and leadership critical knowledge of the network status. Additionally, exercise participants perceived the attribution process (confirm whether Red Teams caused the effect) as cumbersome and slow, and in several cases, simply ignored this process, further detracting from the ability to develop a concise and accurate view of the networks under observation.

Most network compliance attributes continue to gradually improve, indicating greater compliance with basic standards (see Figure 2). Network boundary defense compliance continued to improve, including the presence of host-based intrusion detection tools, improved configuration management of networks and security tools, and the overall infrastructure supporting the operational networks. Physical environment, enclave boundary protections, and incident management is improving. The effective use of host-based intrusion detection systems, for example, is increasing.

The ongoing fielding of the Host-Based Security System (HBSS) is improving compliance with having local network protection and intrusion detection; however, the majority of HBSS suites DOT&E observed were found to be incorrectly or ineffectively configured. Enforcement of configuration standards; the deliberate planning for incident responses; and critical network infrastructure practices to include having backup components, supplies, and spares continue to improve. In at least one assessment, a strict enforcement of these basic network requirements resulted in measurably reduced Red Team success. Efforts are also underway at selected CCMDs to document and develop Computer Network Defense playbooks as training and operational tools.

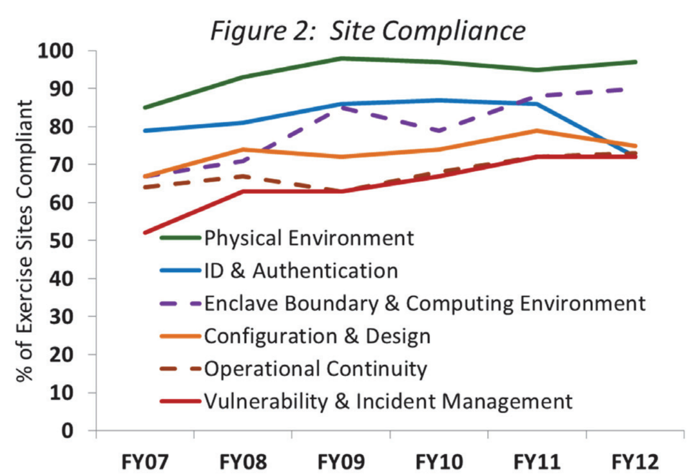


Figure 2: Six-year trend in compliance standards as measured during exercise assessments. Physical environment and enclave protection standards have improved steadily since FY07, but progress in operational network continuity, configuration and design standards, and vulnerability/incident management remain gradual.

DOT&E observed reduced rates of compliance in the use of software and hardware backups and key practices such as port and protocol protections, reliable software baselines, remediation of known vulnerabilities, and effective use of system audit logs. Exercise authorities rarely shift to alternate sites or systems. Most audit logs did not meet the minimum requirements specified, and the identification and remediation of known vulnerabilities has also declined over the last two years. DOT&E also observed that the experience and formal training levels for network defenders, which increased steadily over the last three years, showed a large influx of new or inexperienced personnel in FY12.

Mission Assurance

During the FY12 assessments, the operational testers analyzed the IA and IOP findings to characterize the operational effects, or potential operational effects, on specific missions. Although cyber-adversary activities posed a high risk to critical operations, exercise authorities seldom permitted disruptions to be fully exercised; the priority to achieve other exercise training objectives remains at odds with exercising in an environment with representative cyber adversaries and consequently degraded systems. In those exercises where operational effects were permitted, the mission impacts included:

- Disclosure of friendly force locations and activities to the opposition force, resulting in fewer adversary losses
- Denial of critical network capabilities during periods of high operational tempo
- Delays in the delivery of operational data

Despite the few permitted and observable impacts to actual missions, DOT&E analysis of the vulnerabilities, intrusions, and compliance trends clearly indicates high-risk to operational tasks and Combatant Commander operational missions. DOT&E analysis indicates that without the development of defensive tactics commensurate with the sophistication of our adversaries, large-scale compromise or loss of operational data and operational systems during high-tempo operations cannot be discounted.

REPORTS

Each of these assessments resulted in a specific report for the Exercise Authority (CCMD or Service) detailing problems found during the exercise and detailed observations and recommendations. In addition to these, DOT&E published five memoranda of findings and initiated research on nine additional areas of concern in FY12. Finding memoranda detail specific shortfalls and vulnerabilities that have the potential to significantly degrade operations and warrant senior leadership attention. DOT&E identified the shortfalls and vulnerabilities to the responsible leadership. Service and CCMDs provided replies to DOT&E detailing mitigation efforts, which then are subject to subsequent re-evaluation and validation in future assessments. During the fiscal year, where observable, DOT&E reviewed or validated in the field solutions to prior findings. New findings released or researched in FY12 are listed below.

Released in FY12:

- Air Operations Center (AOC) Interoperability (released November 2011) – documented the lack of a consistent software baseline and interoperability certification in the Air and Space Operations Centers
- Virtual Secure Enclaves (released December 2011) – documented a promising network security experiment at USPACOM
- Third Party Patching (released January 2012) – documented a lack of central management for security patches on commercial software in use within DoD networks
- Active Directory Pass-the-Hash (released March 2012) – documented a classified investigation into a common hacker technique
- Assessment of DoD IA during Major CCMD and Service Exercises (published April 2012) – documented a detailed follow-up to the FY11 Annual Report, specifically addressing classified IA issues

Research Initiated in FY12:

- HBSS discrepancies in asset management (initiated March 2012 and released October 2012) – investigating a potential common misconfiguration of the system that causes inaccurate or inconsistent results
- Event attribution (initiated May 2012) – investigating the manner in which events detected during an exercise are attributed to either Red Team activity or actual cyber incidents
- Shipboard Systems (initiated July 2012) – investigating a possible vulnerability to afloat systems
- Physical Intrusion Devices (initiated July 2012) – investigating the use of a commonly available hacker tool
- Password shortfalls (initiated July 2012) – investigating common password errors exploited by Red Teams
- Unsecured chat systems (initiated July 2012) – investigating the operational effects of using collaboration tools that can be easily intruded/exploited
- Phishing and misuse of secure socket technology (initiated July 2012) – investigating the operational effects of two common hacker techniques
- Physical Security (initiated July 2012) – investigating multiple instances and causes of failures to physically protect network resources and points of access
- Surveillance Radar Systems (initiated September 2012) – documenting a possible control-of-radar interoperability problem

FY13 PLANS AND GOALS

DOT&E's goal is to complete at least one IOP and one IA assessment of each CCMD and Service during the fiscal year, with 15 CCMD and Service exercises already identified for FY13 (see Table 2). One of the planned FY13 assessments will involve units already deployed to the U. S. Central Command (USCENTCOM) areas.

The FY13 IA/IOP Assessment Program will focus on the following goals:

- Supporting and monitoring the three-year implementation of the CJCS EXORD, and continuing to improve the realism of portrayed cyber threats during assessments
- Developing and implementing additional improvements to the methods for gathering and assessing the effects on operational missions
- Increasing coordination with USCYBERCOM, DISA, DoD CIO, and other agencies in the scheduling and conduct of assessments
- Continuing to expand the use of the DoD Joint Information Operations Range (JIOR) and other range/test facilities in support of exercise assessments
- Continuing to refine the mission assurance analysis afforded by the IA and IOP findings

TABLE 2. INFORMATION ASSURANCE AND INTEROPERABILITY EXERCISE EVENTS PROPOSED FOR FY13

EXERCISE AUTHORITY	EXERCISE	ASSIGNMENT AGENCY
U.S. Africa Command	Judicious Response 2013	ATEC
U.S. Central Command	AOR Site Assessment	ATEC
	Internal Look 2013	ATEC
U.S. Cyber Command	Cyber Flag 2013	ATEC
U.S. European Command	AOR Site Assessment	ATEC
North American Aerospace Defense Command / U.S. Northern Command	Vigilant Shield 2013	AFOTEC
U.S. Pacific Command	Terminal Fury 2013	COTF
U.S. Southern Command	Integrated Advance 2013	ATEC
U.S. Special Operations Command	Emerald Warrior 2013	ATEC
U.S. Strategic Command	Global Lightning 2013	JITC
U.S. Transportation Command	Turbo Challenge 2013	JITC
U.S. Army	Warfighter 13-4	ATEC
U.S. Navy	Aircraft Carrier Battle Group (CVBG) Assessment	COTF
U.S. Air Force	Blue Flag 2013	AFOTEC
U.S. Marine Corps	II Marine Expeditionary Force	MCOTEA

AOR – Area of Responsibility AFOTEC – Air Force Operational Test and Evaluation Center ATEC – Army Test and Evaluation Command
COTF – Commander, Operational Test and Evaluation Force JITC – Joint Interoperability Test Command
MCOTEA – Marine Corps Operational Test and Evaluation Activity

INFRASTRUCTURE OBSERVATIONS

While exercise commanders permitted degraded network operations on almost twice as many unclassified network sites than the previous year, the instances of degraded performance on classified networks declined slightly. Exercise authorities remain cautious about permitting advanced threat depictions or advanced network effects that may endanger other exercise objectives, or be inappropriate for conduct on live networks.

The use of cyber ranges and laboratories increased in FY12, with four exercises incorporating ranges to support exercise conduct: RED FLAG 2012, CYBERFLAG 2012, TERMINAL FURY 2012, and WARFIGHTER 2012-4. For RED FLAG and CYBERFLAG, the use of the cyber range was integral to the exercise, whereas during the TERMINAL FURY and WARFIGHTER exercises, cyber range use supplemented and enhanced the training scenarios but was not central to the exercises. In all four instances, the use of the ranges permitted more advanced threat and network activities.

The CJCS EXORD of February 2011 directed more realistic cyber adversary portrayals in all major CCMD and Service-level exercises, but did not specify all of the necessary resources to accomplish this tasking. Expanded use of range facilities has been demonstrated to both enhance and expand the ability to depict wider varieties of cyber activities. Furthermore, many DoD networks have transitioned from direct CCMD management and oversight to "ownership" by consolidated cyber service providers or Service component cyber commanders.

The networks supporting USAFRICOM and USEUCOM, for example, are now consolidated under the Joint Enterprise Network (JEN) for the theater and under the control and management by the Army Signal Brigade in that theater. A number of Air Force networks are similarly consolidating.

All of these consolidations are consistent with the Department's plans for a Joint Information Enterprise, but this has further complicated the tasks of planning and executing realistic assessments. In recent exercises, the assessing agency either experienced critical delays or was unable to obtain approved ground rules, authorizations, or support for cyber adversary activities during the exercise. This was largely due to the cyber component's inability to support the additional activities required by the exercise, or the lack of sufficient agreements with the supported commander to make such commitments on behalf of the Combatant Commander. As DoD continues to consolidate cyber resources, it will be critical for these agencies to control sufficient resources to support exercises to the degree required by the EXORD. Additionally, the demand for "offline" capabilities, such as training, experimentation, development, and test ranges will increase.

DOT&E continues to support the development of methods and environments to exercise and assess advanced actions on appropriate closed-loop cyber ranges. CCMDs used cyber ranges such as the JIOR in four assessed exercise venues, and emphasis will continue for increasing the integration and operational realism of JIOR events associated with DOT&E's IA/IOP assessments in FY13. DOT&E sponsored a distributed cyber-range experiment in July 2012, where the JIOR was used to connect the National Cyber Range (NCR) with other cyber labs, targets, and attackers. NCR capabilities offer substantial increases in network scaling and substantial reductions in the time required for cyber research, development, training, and testing.

At DOT&E's initiative to enhance the operational realism and threat portrayal in exercises and range environments, DoD championed investments to mature the environments and capabilities needed for testing and training with advanced cyber adversaries. The need for this capability is highlighted by the findings contained in the DOT&E classified report dated April 2012. DOT&E recommended integrating four facilities into an enterprise cyber range to speed implementation of the CJCS EXORD, as well as to meet Section 933 requirements for infrastructure to support the rapid acquisition of cyber warfare capabilities.

Test and Evaluation Resources

Test and Evaluation Resources

Test and Evaluation Resources

Title 10, U.S. Code requires DOT&E to assess the adequacy of operational and live fire testing conducted for programs under oversight and to include comments and recommendations on resources and facilities available for operational test and evaluation and levels of funding made available for operational test and evaluation activities. DOT&E monitors and reviews DoD and Service-level strategic plans, investment programs, and resource management decisions to ensure capabilities necessary for realistic operational tests are supported. This report addresses the major areas of concern in testing current systems and discusses both resource needs and significant issues for operational and live fire testing. Specific capabilities and test resource areas of concern include:

- General Test Infrastructure
- Next-Generation Electronic Warfare Environment Generator (NEWEG)
- Integrated Technical Evaluation and Analysis of Multiple Sources (ITEAMS)
- Advanced Electronic Warfare (EW) Test Resources
- Cyber Warfare
- Explosive Surrogate for Use in Live Fire Test and Evaluation (LFT&E)
- Tactical Engagement Simulation (TES) and Real Time Casualty Assessment (RTCA)
- Joint Urban Test Capability (JUTC)
- Fifth-Generation Aerial Target
- Automated Test Capabilities for Software-Based Systems
- Steerable Antenna for GQM-163A Supersonic Target Testing
- Additional Electronic Warfare (EW) Simulator Units for Surface EW Improvement Program (SEWIP) Block 2
- Continuing Radio Frequency Spectrum Concerns
- Renewable Energy Infrastructure Impact on Operational Testing

General Test Infrastructure

The DoD budget remains under severe fiscal pressure, and the DoD faces significant budget uncertainty due to legislation limiting Federal spending. In addition to uncertain budgets and funding challenges, the test infrastructure faces technological and policy challenges and risks in maintaining capabilities to test and evaluate the effectiveness, suitability, survivability, and/or lethality of current and future defense systems. The Test Resources Management Center (TRMC) identified a variety of near-term test infrastructure needs in developing the 2012 Strategic Plan for DoD T&E Resources. Some of these needs include:

- Addressing near-term maintenance, sustainment, and modernization needs of T&E facilities across the Services due to obsolescence and equipment deterioration
- Managing the current workforce while shaping future workforce requirements to meet the sophisticated T&E and acquisition challenges brought about by emerging technology
- Developing an investment and operational strategy to produce unmanned and autonomous systems test capability in the air, land, and maritime domains
- Continuing initial efforts to develop a cyberspace test infrastructure capability that provides blue, red, and gray environments with representative threats to offer both defensive and offensive cyber operations

The test infrastructure provides critical support for operational and live fire testing, and DOT&E is working closely with the Deputy Assistant Secretary of Defense, Developmental Test and Evaluation (DT&E)/Director, TRMC to ensure that the DoD retains sufficient core capabilities to conduct realistic testing. DOT&E has also engaged in the DoD budget process to address problems with electronic warfare threat simulators, the cyber range, and body armor testing.

Savings in Test Infrastructure.
Given the current and projected fiscal environment, DOT&E understands fully the need to seek savings in all areas of the Department's activities and infrastructure, including testing and test infrastructure. The need for cost-effective testing is a key reason DOT&E continues to require that test plans incorporate the use of rigorous statistical methods for determining the scope and breadth of operational testing and for evaluating the data produced by that testing. During the past year, the developmental test office has attempted to identify savings that could be accrued within the Department's test infrastructure, as well as by adopting revised testing practices, and has produced a draft "Comprehensive Review of Test and Evaluation Infrastructure." Although adoption of some of the report's proposals for revised practices would be beneficial, the draft report provided to DOT&E for review has serious shortcomings. Savings taken within any of the Department's activities or infrastructure must be based on actions that are clearly defined and can, therefore, actually be taken; must be capable of assignment to specific elements of the defense budget; and, must be based on credible estimates. Unfortunately, the draft report reviewed by DOT&E satisfies none of these important prerequisites.

Next-Generation Electronic Warfare Environment Generator (NEWEG)

Electronic Warfare (EW) threat simulation capabilities must meet ever-expanding requirements for future strategic, tactical, and support aircraft with electronic combat support systems. These requirements are the result of the increasing sophistication and capabilities of threat radars and the increasing detection and processing capabilities of EW systems, as well as the need for higher-fidelity simulation capability to provide closer correlation between laboratory testing and flight testing. Such a simulation capability would reduce overall test costs and allow greater confidence in laboratory results. To meet these emerging EW requirements, a new generation of EW simulators must make use of state-of-the-art technologies, including modular and scalable architectures, high-speed processing, and integrated radio frequency (RF) subassemblies. The T&E community requires advanced software models to represent platform motion, direction-finding, modulation, and environmental conditions. There is currently no capability to characterize multiple interdependent jammers that simultaneously jam different targets in different bands in different locations in space.

The NEWEG project will use a state-of-the-art, high-fidelity, modular, scalable and reconfigurable EW environment generator and a dynamic multi-beam characterization capability for current and future EW systems testing. It will also establish commonality among DoD stimulators. NEWEG will support both developmental and operational testing and is intended to satisfy shortcomings at Modeling and Simulation and Hardware-in-the-Loop Labs, Installed Systems Integration Facilities, and Open-Air Ranges. The Tri-Service Electronic Warfare Test Capability Study identified these shortcomings in August 2010.

The technical objective of NEWEG is to evolve the state-of-the-art in EW simulation and stimulation technology into much higher-fidelity threat signal simulation. Additional project benefits include establishing commonality between DoD stimulators (leading to improved test repeatability) and continuity between ranges and facilities (resulting in reduced preparation time and cost). NEWEG is intended to:

- Incorporate an open-architecture design facilitating information sharing between EW testers
- Incorporate dynamic jammer recording and analysis
- Include a limited closed-loop threat response capability for Electronic Attack reactivity evaluation
- Allow playback of collected Intelligence/SEI (Specific Emitter Identification) waveforms
- Incorporate an integrated dynamic motion-based RF receive/transmit and analysis subsystem into the Advanced Systems Integration Laboratory (ASIL) at Patuxent River, Maryland

This capability is required for adequate operational testing of F-35 Block 3 in FY17 and beyond. NEWEG development is estimated to cost $23.9 Million to meet the threshold Key Performance Parameters (KPPs) for the system and $33.9 Million to achieve the objective KPPs.

Integrated Technical Evaluation and Analysis of Multiple Sources (ITEAMS)

After the fall of the Soviet Union, U.S. testers were able to acquire foreign military weapon systems for testing U.S. weapon systems. The emergence of new potential adversaries in the past two decades has created a threat situation in which foreign assets are not available for exploitation or testing. The Threat Systems Program (TSP) supports U.S. Service members by providing threat intelligence to ensure operational and developmental testing occurs against realistic threat representations. TSP is a partnership of the intelligence, operational testing, and acquisition communities in the DoD. Under a memorandum of agreement between DOT&E and the Defense Intelligence Agency (DIA), the Test and Evaluation Threat Resource Activity (TETRA), within the Missile and Space Intelligence Center, executes the TSP and provides ongoing intelligence analysis and support for DOT&E threat resources while managing and overseeing a DOT&E investment program for the development of threat resources.

TSP pioneered the use of intelligence deep-dives, going beyond the normal intelligence mission to perform intelligence research and analysis necessary to develop threat simulators. These efforts, known as Integrated Technical Evaluation and Analysis of Multiple Sources (ITEAMS), can result in threat representations such as models and simulations or produce blue-print designs for constructing open-air operational test assets, such as hardware solutions representing a threat capability or function.

During FY12, TSP completed ITEAMS projects on land and sea threats. A scientific and technical intelligence staff translated all source technical intelligence on a widely proliferated battle management and command, control, communication, and computer system into a model to support test and evaluation. The model is intended to provide real-time man-in-the-loop operations in an electronic attack environment. Two projects starting in FY12 will address medium-range surface-to-air missile threats from two different adversaries, leveraging previous intelligence collection and analysis on these systems and their predecessors. These efforts are in addition to recently completed ITEAMS of threat Advanced Air Defense Systems. In FY12, DOT&E authorized funding of 10 new ITEAMS to address critical operational test needs for 2014 and beyond.

Advanced EW Test Resources

In February 2012, DOT&E identified shortfalls in EW test resources that prevent development, testing, and timely fielding of U.S. systems capable of operating successfully against threats that currently exist, are proliferating, and are undergoing an accelerating pace of significant upgrades. Subsequently, DOT&E identified the need for approximately $495 Million in funding from FY13-18 to address these shortfalls and assure the needed test resources would be available in time to support developmental and operational testing of systems including the Joint Strike Fighter. The DOT&E recommendations included accelerating the NEWEG program's production of high fidelity signal generators, upgrading the government anechoic chambers with adequate numbers of signal generators from the NEWEG program for realistic threat density, upgrading the Joint Strike Fighter mission data file reprogramming lab to include realistic threats in realistic numbers, providing ITEAMS products needed to guide threat simulations, and developing a combination of open and closed-loop threat simulators in the numbers needed for operationally realistic open-air range testing.

DOT&E participated in a "tiger team" assigned by USD(AT&L) to review the shortfalls identified by DOT&E, which concurred with DOT&E's conclusions and recommended additional enhancements. The combination of improved government-owned anechoic chambers and new open-air range test assets is needed to evaluate the advanced capabilities under development in the Joint Strike Fighter, F-22 Increment 3.2 A/B, B-2 Defensive Management System, Long-Range Strike Bomber, Next Generation Jammer for the EA-18G, Integrated Defensive Electronic Countermeasures upgrades, as well as several other programs. DOT&E is pursuing, along with the TRMC, the necessary actions to acquire the test assets and integrate them into operational test plans. Absent these test resources, development and adequate, realistic testing of the systems cited above will not be possible.

Cyber Warfare

The capacity to assess realistically advanced cyber warfighting capabilities must be increased to keep pace with heightened demand for those capabilities, advancing technologies, and the growing cyber threat. In February 2011, the Chairman of the Joint Chiefs of Staff issued a memorandum directing that all major exercises include realistic cyber adversary elements as a training objective. To comply with this order, more non-major exercises are needed, and these exercises must include realistic cyber adversaries. The Joint Information Operations Range offers a multi-level security environment to integrate and conduct simultaneous cyber activities.

DOT&E identified a $90 Million need over the Future Years Defense Program (FYDP) to upgrade range operations and capacity to conduct additional events, handle larger amounts of message traffic, and portray cyber threats and responses with increased fidelity. Additionally, DOT&E estimates $59 Million over the FYDP is needed to provide additional capabilities for realistic threat development and assessment, as well as additional expertise and training for the Red Teams employing cyber threats during training and test events. Lastly, DOT&E estimates additional funding of $46 Million across the FYDP will support assessments during all appropriate Combatant Commander and Service exercises.

Explosive Surrogate for Use in Live Fire Test and Evaluation (LFT&E)

Title 10, U.S. Code requires realistic survivability testing of combat and tactical wheeled vehicles against combat-realistic threats. DOT&E oversees survivability testing and has concerns about our ability to test operationally significant scenarios involving underbody blast threats, thereby assuring adequate LFT&E of military vehicles now and in the future. The significant concerns include the need to:

- Develop and rigorously characterize the performance of a surrogate for the Home-Made Explosive (HME) threats now prevalent in Afghanistan because of their ease of fabrication and efficacy, both of which argue for the use of HME by enemies in future conflicts. Currently, LFT&E cannot use HME surrogates because the performance of those surrogates (that is, the blast impulse they deliver to a vehicle) vary greatly from test to test for reasons that are not fully understood. LFT&E requires repeatability from test to test, which can be achieved only when the key factors determining the performance of HME surrogates are known and can be controlled.
- More fully characterize the performance of buried TNT devices, which are the standard threats currently used in LFT&E. The blast impulse delivered by buried TNT to a vehicle is repeatable under the relatively narrow set of conditions now used in LFT&E. However, there is a need to test and compare results obtained under more widely varying conditions.
- Characterize how differences in soil composition affect the blast impulse delivered to vehicles undergoing underbody blast testing. The currently used single standard soil presents multiple limitations to testing for numerous reasons. It does not allow for roadbed compaction, realistic under-wheel threat placements, varying moisture content, or varying soil composition. This constrains the LFT&E community's ability to evaluate vehicle vulnerability to underbody blast threats for certain critical, operationally significant scenarios. Additionally, the Army may soon be unable to continue procuring soils that meet the current standard.

Proposed funding of $15 Million for FY13-15 will enable the Army to complete the full scope of effort required to ensure adequate LFT&E of military vehicles against underbody blast threats. Understanding of blast threats will enable improvements to vehicle design and capabilities against underbody blast threats that will save lives in current and future conflicts.

Tactical Engagement Simulation (TES) and Real Time Casualty Assessment (RTCA)

New and upgraded combat systems cannot be adequately evaluated without the exchange of simulated fire between friendly and opposing forces in an operationally realistic environment. These force-on-force battles must contain enough realism to cause Soldiers and their units to make tactical decisions and react to the real-time conditions on the battlefield. Real Time Casualty Assessment (RTCA) is needed to ensure that the simulated engagements have realistic outcomes based on the lethality and survivability characteristics of both the systems under test and the opposing threat systems. Future Tactical Engagement Simulation (TES)/RTCA systems must include critical attributes of real-world combat engagements such as direct and indirect fires, IEDs and mines, realistic battle damage and casualties, a mix of ground and air vehicles, and a competent and capable threat force. TES/RTCA systems must be able to record the time, space, position; and firing, damage, and casualty data for all players in the test event. Current TES systems cannot support the simulated engagements or the data collection needed for OT&E.

Past efforts by the Army test community to develop a TES/RTCA capability have failed due to affordability issues. Army Operational Test Command has begun a study to review the operational test requirements for RTCA, examine applicable technologies, and recommend a course of action for future developments. The Army has also initiated work on the Army Tactical Engagement Simulation System (A-TESS) program, which seeks to increase interoperability and provide interface standards for future capability growth of its TES systems. The offices responsible for test and training in the Army are committed to working together toward a future system due to their common requirements and limited budgets. DOT&E supports these initiatives and will continue to require an adequate RTCA system to support the OT&E of combat systems such as the Ground Combat Vehicle, Abrams Tank Modernization, Armored Multipurpose Vehicle, Apache Block III, Joint Lightweight Tactical Vehicle, and Stryker upgrades. The estimated cost to develop this capability is $125 Million.

Joint Urban Test Capability (JUTC)
Operations in urban environments present unique challenges to Service members and their equipment. Degraded mobility, communications, and situational awareness; a large civilian presence; the risk of collateral damage; reduced stand-off distances; and unique threat profiles are some of the obstacles present during urban operations. These challenges justify the requirement that systems be tested in operationally realistic urban environments. The Army-led Urban Environment Test Capability (UETC) study has determined the resources needed to support the T&E of systems operating in urban environments. The UETC summarized this information, along with a study of global urban landscapes, in its final report. The UETC report is the foundation for the Joint Urban Test Capability (JUTC) project being led by the Army and funded through the OSD Central Test and Evaluation Investment Program.

DOT&E is supportive of the JUTC requirement; however, the proposed physical surface urban area of 200 meters by 240 meters will not be large enough to support operational testing of Company size and greater test scenarios. DOT&E recommends that the urban area be expanded to the JUTC objective requirement of 900 meters by 900 meters to support future operational test events. The cost of the current JUTC effort is estimated at $75-95 Million. DOT&E is coordinating with the TRMC on the feasibility of expanding the JUTC to the larger area.

Fifth-Generation Aerial Target
No U.S. aerial target (including the QF-16 currently in development) can replicate fifth-generation fighter characteristics such as low observability or embedded electronic attack. As a result, operationally realistic testing cannot be accomplished for U.S. air-to-air and surface-to-air weapons systems against fifth-generation fighters. Therefore, DOT&E is executing a target design and cost study based on the recommendation of the Defense Science Board with a goal of determining if an affordable Fifth-Generation Aerial Target can be developed. The contractor and Institute for Defense Analysis (IDA) provided preliminary cost estimates in FY12. DOT&E will focus on mitigating risk and resolving cost uncertainty as the study continues in FY13. DOT&E is seeking $60 Million to develop a production-representative prototype(s) to validate cost and performance during flight test in FY15. This capability is required for adequate developmental and operational testing of the Department's ongoing and planned aircraft and missile programs.

Automated Test Capabilities for Software-Based Systems
Current acquisition policy (DoDI 5000.02) requires "manufacturing processes under control" as an entrance criterion for a Milestone C decision for full-rate production. DOT&E now requires an equivalent concept for software acquisitions and software components of a weapon system at IOT&E. Specifically, program managers must demonstrate software system sustainment maturity, including program-conducted T&E in support of routine technology upgrades. A demonstration of sustainment maturity will include a demonstration of applicable test automation and the ability to perform an end-to-end trace of test information from requirements to test scripts and defects.

We anticipate that most programs will take several years to create a software test automation approach that will satisfy the DOT&E requirements. Currently, programs complete test automation and an end-to-end trace of test information on a per program basis at varying levels of adequacy. Very few acquisition programs have mature test automation solutions for regression testing that can be demonstrated at IOT&E, and even fewer programs can create the environments and conditions to validate their regression testing processes. Without substantial help from a central resource, it is likely that most programs will have this deficiency during IOT&E.

The need for software test automation strategies to satisfy DOT&E requirements will create demand for test automation expertise in program offices. Program managers need a resource, such as a center of excellence, to help meet that demand and mitigate problems. A center of excellence will work with vendors and government providers to promote interoperability of Test as a Service (TaaS) and other test automation solutions. This center of excellence is intended to:

- Centralize knowledge of the various automation approaches
- Assist programs in applying software test automation
- Create "in-house" software test automation expertise

A center of excellence may lessen the tendency to use a "stove-piped" approach to testing, may reduce duplicative resources (technological and human), should increase programs' use of existing capabilities, and should improve the consistency and adequacy in the types of testing accomplished. DOT&E estimates the DoD will need $2 Million over the next two years to establish a software test automation center of excellence that will subsequently be self-supported through fees for test services.

Steerable Antenna for GQM-163A Supersonic Target Testing

A steerable antenna unit is required to provide operationally realistic emissions from the GQM-163A supersonic target that will stay locked on the target ship. This unit is needed to ensure the shipboard EW system has constant track of the incoming target emissions so that Rolling Airframe Missile Block 1 and/or Block 2 missiles can then be launched (and guide on those same emissions) as interceptors. This unit would be similar to the STEERAN unit currently used in the BQM-74E subsonic target. The diameters of the GQM and BQM targets differ greatly, so extensive re-engineering and testing will be needed to adapt the BQM unit to fit the GQM without disturbing the GQM kinematics/maneuverability. This capability is required for adequate operational testing of the CVN-78/Rolling Airframe Missile Block 2 in FY17. Estimated development cost is $10-20 Million. Estimated unit cost is $500 thousand.

Additional EW Simulator Units for Surface EW Improvement Program (SEWIP) Block 2 OT

At present, there exists only one each of the Kappa, Uniform, and Gamma EW simulators. These simulators are flown on Lear Jets against shipboard EW systems. SEWIP Block 2 is the latest EW system under development. Two of these simulators are needed (one for each Lear Jet) so that threat-realistic stream raid profiles can be used to adequately test the SEWIP Block 2 in FY14. An estimated development/procurement cost is $5 Million.

Continuing Radio Frequency Spectrum Concerns

The T&E community competes with commercial and other federal entities for access to the RF spectrum. RF spectrum allocated to commercial uses has increased due to reallocation of the government spectrum and petitioning of the Federal Communications Commission (FCC) for additional frequency assignments. The result is insufficient spectrum to support T&E telemetry operations (primarily in the L and S frequency bands) and FCC restrictions on DoD RF emissions and jamming operations (so as not to interfere with commercial RF use). This problem is exacerbated by the growth in data transmission rates needed as more complex weapon systems are developed (by the U.S., allies, and adversaries) and as the military must demonstrate RF spectrum exploitation to disrupt and deny spectrum access by adversaries. Funding and support from Congress as well as other federal agencies is needed to ensure adequate RF spectrum to support T&E. The objective would be to pursue the following:

- Protect critical T&E RF spectrum bands from reallocation.
- Acquire additional RF spectrum to offset reallocated spectrum. This would include development of a multi-Service implementation plan to ensure acquisition programs and range facilities implement the means to utilize the additional spectrum.
- Develop methods and technologies that more efficiently use the RF spectrum.

TRMC estimates the cost to retain the current capacity of the ranges (i.e., the number of test operations) is on the order of $400 Million over five years due to continued growth of data transmission rates, the associated costs of developing the technologies needed to support these data transmission rates, and continuing encroachment on the spectrum needed for testing.

Renewable Energy Infrastructure Impact on Operational Testing

Testing and evaluation of weapons, sensors, command and control networks, and other sensitive technologies often require an electromagnetic environment free of interference. The proliferation of wind and solar renewable energy projects has had an increasing impact on DoD testing and evaluation in an electromagnetic environment. Although most renewable energy projects are compatible with the DoD test capabilities, in some cases, they can interfere with test range instrumentation resources and systems under test. Collocation of wind and solar power renewable energy projects with test resources is requiring careful evaluation and investigation of a variety of potential mitigation strategies, since many of the Nation's most productive wind and solar energy resources exist in close proximity to some of the DoD's most critical test ranges. For example, wind farms located in the Tehachapi Mountains in California currently restrict the ability to test certain airborne radar systems along west-to-east approach vectors to simulated targets. Additionally, proposed new renewable energy developments in the northern Mojave Desert could more severely affect these tests on the east-to-west approach vector. These renewable energy resources may eliminate the ability of the DoD to validate design parameters of radar systems in the southern California/Nevada region test ranges.

There are known sources of interference with test range capabilities from energy infrastructure projects, such as those identified in California and Nevada. Since DoD is only beginning to evaluate such areas of interference because renewable energy development on a large scale did not occur until recently, more data on interference from the various types of renewable energy projects are needed to determine the significance of its effects. Similarly, research is required to develop interference mitigation techniques and technologies.

DoD has observed interference in the following areas: wind turbines on DoD radar systems, central solar power tower impact on radar cross section evaluation, electromagnetic interference from transmission lines, and physical obstruction from transmission lines.

To address these interference problems, DOT&E is working with the DoD Siting Clearinghouse to evaluate proposed renewable energy and infrastructure projects as well as develop expertise in understanding interference issues and establish a strategy for research that will produce mitigation techniques and technologies to resolve interference issues.

Joint Test and Evaluation

Joint Test and Evaluation

Joint Test and Evaluation (JT&E)

The primary objective of the Joint Test and Evaluation (JT&E) Program is to provide rapid solutions to operational deficiencies identified by the joint military community. The program achieves this objective by developing new tactics, techniques, and procedures (TTPs) and rigorously measuring the extent to which their use improves operational outcomes. JT&E projects may develop products that have implications beyond TTPs. Sponsoring organizations submit these products to the appropriate Service or Combatant Command as doctrine change requests. Products from JT&E projects have been incorporated into joint and multi-Service documents through the Joint Requirements Oversight Council process and through coordination with the Air, Land, Sea Application Center. The JT&E Program also develops operational testing methods that have joint application. The program is complementary to, but not part of, the acquisition process.

The JT&E Program has re-engineered its business model in response to a budget reduction starting in FY13. The major change is that project life cycle is reduced to two years from the current three years. To accommodate this shorter timeline, nominating organizations must submit a robust initial nomination package that provides substantial detail on how they will achieve test objectives. The new business model of conducting shorter test projects necessitates establishing permanent test units, managed by operational test agencies, supporting test projects led by the operational sponsor. This new business model reduces the number of staff members needed to support a joint test and improves the stability of personnel assignments.

The program managed six joint tests in FY12 that focused on the needs of operational forces. Projects annotated with an asterisk (*) closed in FY12:

- Joint Advanced Capability Employment (J-ACE)
- Joint Cyber Operations (JCO)
- Joint Deployable Integrated Air and Missile Defense (JDIAMD)
- Joint Integration of Maritime Domain Awareness for Homeland Defense (JIMDA)*
- Joint Jamming Assessment and Mitigation (JJAM)*
- Joint Unmanned Aircraft Systems (UAS) Digital Information Exchange (JUDIE)

The JT&E Program instituted a quick reaction test (QRT) capability in 2003 to respond to the pressing needs of today's deployed forces. QRTs are less than a year in duration and solve urgent issues. The program managed 16 QRTs in FY12:

- Afghanistan Mission Network Coalition Battlespace Management (AMN-CBM)*
- Airborne Maritime Moving Target Indicator (AMMTI)*
- Battlefield Airborne Communications Node (BACN) Intra-Flight Data Link Subsystem and Multi-Domain Integration (BIS-MDI)
- Civil Intelligence Fusion Concept of Operations (CIFC)
- Computer Network Defense Service Provider (CNDSP)
- Joint All-Domain Situational Awareness (J-ADSA)
- Joint Analytical Network Assessment (JANA)*
- Joint Battlespace Awareness via Data Link (J-BADL)
- Joint Beyond Line-of-Sight Command and Control (JBC2)
- Joint Exploitation of Modern Surface-to-Air Missile Systems (JEMS)*
- Joint Military Working Dog (JMWD)*
- Joint Passive Electronic Radio Frequency Emission Classification and Tracking II (J-PERFECT II)*
- Joint Threat Assessment and Negation for Installation Infrastructure Control Systems (JTANIICS)
- Joint Vehicle Protection and Survivability System (JVPSS)*
- Rapid Development and Sustainment of Enterprise Mission Services (RDEMS)*
- Unmanned Aircraft Systems – Airspace Integration (UAS-AI)

The program executes special projects, as directed by DOT&E, which address problems DoD-wide. The program managed one special project in FY12, the Rapid Acquisition by Sniper1K Track and Attack (RASTA).

JOINT TESTS

JOINT ADVANCED CAPABILITY EMPLOYMENT (J-ACE)

Sponsor/Start Date: U.S. Strategic Command/August 2011

Purpose: To develop, test, and evaluate a standardized process to support the Joint Force Commander's ability to employ enhanced, advanced capabilities to overcome complex targeting challenges.

Products/Benefits: The J-ACE-developed products are:

- A repeatable operational employment process that will enhance planning by developing, evaluating, and coordinating concepts of employment (CONEMPs) that can be used by the Joint Staff, Combatant Commands, Services, and National Security Agency to solve complex targeting challenges
- Multiple approved, enhanced, and advanced capability CONEMPs to overcome complex targeting challenges
- Relevant training scenarios and vignettes
- Documented effects associated with techniques against representative targets
- Recommendations to operational concept of operations (CONOPS) and approval process packages

JOINT CYBER OPERATIONS (JCO)

Sponsor/Start Date: U.S. Pacific Command (USPACOM)/August 2010

Purpose: To develop, assess, and evaluate joint TTPs to employ an adaptive cyber defense Virtual Secure Enclave (VSE) to ensure the protection and availability of critical command and control services.

Products/Benefits:

- Addresses network vulnerabilities of critical command and control services by enabling Joint Task Force Commanders to employ an adaptive cyber defense VSE to protect against, detect, and respond to cyber threats against specific command and control applications at the operational level
- Provides the Commander with situational awareness and cyber defense options to maintain a proactive defensive posture
- Facilitates a systematic approach to warfighting in the cyber domain
- Tests and validates operational effectiveness of Joint Task Force implementation

JOINT DEPLOYABLE INTEGRATED AIR AND MISSILE DEFENSE (JDIAMD)

Sponsor/Start Date: North American Aerospace Defense (NORAD), U.S. Northern Command (USNORTHCOM), Army Space and Missile Defense Command/August 2011

Purpose: To develop joint planning and execution processes and procedures for deployable, integrated air and missile defense (IAMD) for the homeland.

Products/Benefits:

- IAMD process modeling that provides a comprehensive view of the integrated planning and execution process
- NORAD and USNORTHCOM current operations planning processes, checklists, and procedures for IAMD
- Continental NORAD Region and Air Forces North planning and execution TTPs for IAMD
- U.S. Fleet Forces and Third Fleet planning and execution TTPs for naval support of IAMD
- Army North planning and execution TTPs for operational control of ground-based IAMD forces
- 263rd Army Air and Missile Defense Command planning and execution TTPs for IAMD

JOINT INTEGRATION OF MARITIME DOMAIN AWARENESS FOR HOMELAND DEFENSE (JIMDA)*

(Closed October 2012)

Sponsor/Start Date: NORAD and USNORTHCOM/August 2009

Purpose: To develop TTPs for consistent and comprehensive coordination across the distributed maritime community in order to synchronize maritime domain information for key decision makers across the operations centers responsible for homeland defense.

Products/Benefits:

- Integrated maritime domain awareness processes, procedures, and checklists for all participating operations centers
- An online handbook detailing the information and resources available for developing and sharing maritime domain information across the NORAD and USNORTHCOM command and control network and among participating interagency partners
- An online portal, hosted by NORAD and USNORTHCOM, that enables the distributed execution of the maritime domain awareness processes, procedures, and checklists during daily operations at participating operations centers throughout the maritime community

JOINT JAMMING ASSESSMENT AND MITIGATION (JJAM)*

(Closed September 2012)

Sponsor/Start Date: Air Force/August 2009

Purpose: To develop TTPs that mitigate the effects of adversary purposeful interference (PI) on satellite communications (SATCOM) and allow friendly operational forces to effectively sustain operations when SATCOM is degraded or denied.

Products/Benefits:

- Created SATCOM PI mitigation training employing live jamming signals that allowed the SATCOM community of interest to rehearse technical and procedural PI resolution processes
- Established SATCOM PI mitigation TTPs and CONOPS being used by U.S. Strategic Command, USPACOM, and U.S. Central Command (USCENTCOM)
- Improved information exchange, situational awareness, and command and control decision processes which reduced the timeline for detection, attribution, and target nomination from days to hours
- Integrated Joint Space Operations Center space target coordination and nomination processes into theater operations
- Produced a first-generation PI visualization tool to provide key decision makers real-time awareness of events affecting operationally critical SATCOM networks
- Published SATCOM PI Training and Exercise Handbook for Combatant Command planners
- Integrated SATCOM PI Mitigation TTPs into 19 joint and Service publications

JOINT UNMANNED AIRCRAFT SYSTEMS DIGITAL INFORMATION EXCHANGE (JUDIE)

Sponsor/Start Date: Air Force/August 2010

Purpose: To develop, test, and evaluate cross-component UAS information exchange TTPs used to improve joint battlespace situational awareness and target prosecution capabilities for the Commanders at the tactical level of brigade and below.

Products/Benefits:

- Standardize UAS information exchange TTPs and checklists
- Standardize terminology for UAS information exchange

* Project closed in FY12

- Integrate information portal and situational awareness display technology currently in use by the components to improve the UAS information exchange efficiency
- Introduce the information exchange TTPs to combat training centers and formal training units

QUICK REACTION TESTS

AFGHANISTAN MISSION NETWORK COALITION BATTLESPACE MANAGEMENT (AMN-CBM)*

(Closed January 2012)

Sponsor/Start Date: USCENTCOM and Defense Information Systems Agency (DISA)/January 2011

Purpose: To measure and evaluate the utility of battlespace management TTPs for both joint and coalition forces.

Products/Benefits: Developed a methodology for use by the Afghanistan Mission Network testing organizations enabling them to test and evaluate the utility of TTPs for executing coalition mission threads, and to execute repeatable test events providing reliable quantitative data.

AIRBORNE MARITIME MOVING TARGET INDICATOR (AMMTI)*

(Closed September 2012)

Sponsor/Start Date: U.S. Southern Command/July 2011

Purpose: To develop TTPs for the employment of the Joint Surveillance Target Attack Radar System (JSTARS) Enhanced Land Maritime Mode (ELMM) in support of the counter-narcotics trafficking mission in U.S. Southern Command's area of responsibility. AMMTI will formulate the first TTPs for employment of the JSTARS radar system for open water surveillance.

Products/Benefits:
- Optimized system parameters for JSTARS maritime employment
- Detailed information on the probability of detection and target location error for the specified AMMTI targets
- Mission planning improvements for JSTARS maritime employment
- TTPs for employment of the JSTARS ELMM capability in multiple Combatant Commands
- Flash Bulletin on JSTARS maritime employment considerations

BATTLEFIELD AIRBORNE COMMUNICATIONS NODE (BACN) INTRA-FLIGHT DATALINK SUBSYSTEM AND MULTI-DOMAIN INTEGRATION (BIS-MDI)

Sponsor/Start Date: USPACOM/November 2011

Purpose: To develop and evaluate TTPs for the BIS-MDI, an upgrade to the basic BACN capability that provides interoperability across multi-band voice and datalink communications and bridges widely separated Link 16 networks. This will greatly enhance situational awareness and operational effectiveness, especially between fourth and fifth generation fighter aircraft and surface shooters.

Products/Benefits:
- BIS-MDI fuses sensor information from multiple sources, including fourth and fifth generation platforms, into the Service member's overall common operational picture
- Joint and coalition Service member CONOPS and TTPs for BIS-MDI employment in support of potential USPACOM operations conducted in anti-access and area-denial environments

CIVIL INTELLIGENCE FUSION CONCEPT OF OPERATIONS (CIFC)

Sponsor/Start Date: Joint Staff/January 2012

Purpose: To test and validate the Civil Intelligence Fusion CONOPS. Many intelligence organizations do not dedicate adequate support to collecting and integrating civil information, preventing the Joint Force Commander from obtaining a holistic view of the operational environment.

Products/Benefits:
- Validated and improved CONOPS for fusion of civil intelligence
- New doctrine change requests for consideration
- Connects sources of civil information with planners, operators, and intelligence professionals creating a community of interest
- Provides processes and architecture for improved information sharing resulting in better knowledge of the operational environment

COMPUTER NETWORK DEFENSE SERVICE PROVIDER (CNDSP)

Sponsor/Start Date: DoD Chief Information Office (CIO)/July 2012

Purpose: To develop, document, and formalize Department-level TTPs to ensure the capability exists within DoD CNDSPs to guide day-to-day operations and ensure an acceptable level of performance of DoD CNDSP defenders when facing a capable cyber adversary.

Products/Benefits: The CNDSP QRT will develop a methodical, repeatable, and verifiable framework for measuring the effectiveness of DoD CNDSPs on the Non-secure Internet Protocol Router Network and Secret Internet Protocol Router Network.

* Project closed in FY12

JOINT ALL DOMAIN SITUATIONAL AWARENESS (J-ADSA)

Sponsor/Start Date: NORAD and USNORTHCOM/June 2012

Purpose: To develop and test necessary TTPs to improve the ability of NORAD and USNORTHCOM senior leaders to gain and maintain comprehensive, integrated all-domain situational awareness and decision superiority.

Products/Benefits: The J-ADSA QRT will develop and evaluate the effectiveness of TTPs to access and analyze the effectiveness of seemingly unrelated cross-domain activities and events to enable the NORAD-USNORTHCOM leadership to make timely decisions.

JOINT ANALYTICAL NETWORK ASSESSMENT (JANA)*

(Closed January 2012)

Sponsor/Start Date: USNORTHCOM/January 2011

Purpose: To develop, test, and validate a mission essential circuit list (MECL) for all inter-landmass command circuit service designators in the Pacific theater, supporting operations plans and critical mission operations, both inside and outside the USPACOM area of responsibility.

Products/Benefits:

- Created a methodology utilizing an analytical hierarchy process to develop standardized inter-landmass MECLs and TTPs for use of MECLs during strategic communication restoration
- Command leadership can now properly sequence restoration efforts based on inter-landmass MECLs to ensure the most important capabilities are restored first

JOINT BATTLESPACE AWARENESS VIA DATALINK (J-BADL)

Sponsor/Start Date: NORAD and USNORTHCOM/August 2012

Purpose: To research and develop TTPs that will focus NORAD, USNORTHCOM, and supporting commands' use of joint global sensor information to provide cuing to address priorities, adjust surveillance assets, or position existing forces in executing the Joint Engagement Sequence against advanced air threats.

Products/Benefits: The expected test product includes TTPs that lay out the processes and procedures for the execution of Joint Engagement Sequence capabilities that can be used operationally by NORAD and USNORTHCOM, as well as by other Combatant Commands and government agencies, against advanced air threats.

JOINT BEYOND LINE-OF-SIGHT COMMAND AND CONTROL (JBC2)

Sponsor/Start Date: Air Force/July 2012

Purpose: To develop and evaluate TTPs so operations centers can better plan and execute integrated employment of Beyond Line-of-Sight Command and Control system of systems to support real-time, bi-directional, full motion video, and collaborative command and control capabilities.

Products/Benefits: The QRT will focus the TTP development on operations at both the Maritime Operations Center and the Air and Space Operations Center in the USCENTCOM area of operations in support of responsive fleet defense and strike operations.

JOINT EXPLOITATION OF MODERN SURFACE-TO-AIR MISSILE SYSTEMS (JEMS)*

(Closed January 2012)

Sponsor/Start Date: Naval Air Weapons Center/January 2011

Purpose: To develop and test TTPs for effectively employing countermeasures to modern surface-to-air missile systems for improving aircrew survivability.

Products/Benefits: The JEMS project provided updates to the Joint Research Assessment and Analysis Center for inclusion in applicable threat simulations. It also produced TTPs and training outlines for incorporation by the Services into applicable aircraft tactics and threat training products.

JOINT MILITARY WORKING DOG (JMWD)*

(Closed April 2012)

Sponsor/Start Date: USCENTCOM/April 2011

Purpose: To develop, test, and validate TTPs to support the ground tactical Commander's use and support of military working dogs while performing counter-IED and counterinsurgency missions.

Products/Benefits: The JMWD QRT developed a single-source document for ground maneuver leaders to plan and execute counter-IED and counterinsurgency missions employing military working dogs. The primary test products included the Integrating Military Working Dogs into Counter-IED and Counterinsurgency Operations Handbook and a quick reference card. JT&E transitioned both of these to the U.S. Army Military Police School with 10,000 copies printed for both training and operational use.

JOINT PASSIVE ELECTRONIC RADIO FREQUENCY EMISSION CLASSIFICATION AND TRACKING (J-PERFECT) II *

(Closed July 2012)

Sponsor/Start Date: NORAD and USNORTHCOM/May 2011

Purpose: To develop and evaluate CONOPS and TTPs for employing DoD intelligence, surveillance, and reconnaissance capabilities that have the potential to improve near real-time situational awareness for decision makers and that will support successful operations against modern strategic threats to the United States and Canada.

* Project closed in FY12

Products/Benefits:

- Detect, track, and identify strategic air threats to North America
- Outline the actions and methods which implement doctrine and describe how forces will be employed in operations
- Make recommendations to Combatant Commands and applicable national agencies other than NORAD and USNORTHCOM

JOINT THREAT ASSESSMENT AND NEGATION FOR INSTALLATION INFRASTRUCTURE CONTROL SYSTEMS (JTANIICS)

Sponsor/Start Date: Air Force/January 2012

Purpose: To develop and validate a risk assessment handbook for use by installation Commanders to strengthen their industrial control system security posture.

Products/Benefits: The JTANIICS handbook:

- Enables the installation Commander to conduct self-assessments of industrial control system vulnerabilities
- Provides guidelines for assigning priority to vulnerabilities based on mission requirements
- Includes a validated methodology that aids in identifying commonly overlooked systems that can potentially allow unauthorized access to mission-critical and safety-critical systems

JOINT VEHICLE PROTECTION AND SURVIVABILITY SYSTEMS (JVPSS)*

(Closed July 2012)

Sponsor/Start Date: USCENTCOM/July 2011

Purpose: To capture lessons learned and best practices to identify, document, and validate the safety and survivability features of the primary ground combat vehicles used in the USCENTCOM area of responsibility.

Products/Benefits: A handbook and training video that contains TTPs, lessons learned, and best practices that maximize Service member survivability when utilizing Mine Resistant Ambush Protected Vehicles, Strykers, and personnel protective equipment. The handbook targets the individual vehicle operator, crew members, and small unit leader with instructions on how to maximize the effectiveness of the safety and survivability features of their vehicle. These instructions are listed as “do’s” and “don’ts” in a graphically intensive, reader-friendly format.

RAPID DEVELOPMENT AND SUSTAINMENT OF ENTERPRISE MISSION SERVICES (RDEMS)*

(Closed July 2012)

Sponsor/Start Date: DoD CIO/July 2011

Purpose: To identify and document impediments to the implementation of the DoD Information Sharing Strategy. The resulting document reflects the lessons learned and updates the CONOPS and TTPs in an RDEMS User Guide, based upon DoD-prescribed standards, specifications, doctrine, and technical processes to enable effective and efficient enterprise information sharing.

Products/Benefits:

- Documented impediments to information sharing at the joint level across Combatant Commands, Services, and other Department organizations
- DoD CIO has taken the impediments for action and is actively working to resolve them
- Product sponsors captured lessons learned from the project use case and updated CONOPS and TTPs in the RDEMS User Guide for use throughout the Department

UNMANNED AIRCRAFT SYSTEMS – AIRSPACE INTEGRATION (UAS-AI)

Sponsor/Start Date: NORAD and USNORTHCOM/January 2012

Purpose: To evaluate a discrete set of flight access profiles from the DoD Airspace Integration CONOPS developed to facilitate UAS integration into the National Airspace System

Products/Benefits: Recommend potential improvements to the CONOPS and provide all test results to the USD(AT&L) UAS Task Force for the purpose of identifying CONOPS gaps revealed by the QRT.

SPECIAL PROJECTS

RAPID ACQUISITION BY SNIPER 1K TRACK AND ATTACK (RASTA)

Sponsor/Start Date: USPACOM/November 2011

Purpose: To develop and test joint TTPs that improve the timely integration of specific target track generating capabilities for tactical fighter aircraft during combat employment in an environment that includes Advanced Electronic Attack waveforms. Concurrent TTP development lays out the process for open architecture changes and additions to the operational flight program for fighter aircraft to enable changes to be made rapidly and inexpensively.

Products/Benefits: RASTA will provide Service members the ability to generate target-quality information to enhance kill chain effectiveness while operating in an Advanced Electronic Attack waveform environment.

* Project closed in FY12

Center for Countermeasures

Center for Countermeasures

The Center for Countermeasures (the Center) is a joint activity that directs, coordinates, supports, and conducts independent countermeasure/counter-countermeasure (CM/CCM) T&E activities of U.S. and foreign weapon systems, subsystems, sensors, and related components. The Center accomplishes this work in support of the DOT&E, Deputy Assistant Secretary of Defense (DASD) for Developmental Test and Evaluation (DT&E), weapon system developers, and the Services. The Center's testing and analyses directly support evaluation of the operational effectiveness and suitability of CM/CCM systems.

Specifically, the Center:

- Performs early assessments of CM effectiveness against threat and DoD systems and subsystems.
- Determines performance and limitations of missile warning and aircraft survivability equipment (ASE) used on rotary-wing and fixed-wing aircraft.
- Determines effectiveness of precision-guided weapon (PGW) systems and subsystems when operating in an environment degraded by CM.
- Develops and evaluates CM/CCM techniques and devices.
- Develops and tests new CMs in operationally realistic environments.
- Provides analysis and recommendations on CM/CCM effectiveness to Service Program Offices, DOT&E, DASD(DT&E), and the Services.
- Supports Service member exercises, training, and pre-deployment activities.

During FY12, the Center tested, analyzed, and reported on more than 40 DoD electro-optical systems or subsystems with special emphasis on rotary-wing survivability. The Center participated in operational/developmental tests for rotary- and fixed-wing ASE, PGWs, hostile fire indicator (HFI) data collection, experimentation tests, and pre-deployment/exercise support involving the use of CM/CCM.

Approximately 53 percent of the Center's efforts were spent on ASE and HFI systems, and 7 percent of the Center's efforts were focused on overseas contingency operations support (with emphasis on CM-based, pre-deployment training for rotary-wing units). About 19 percent of the Center's efforts were spent on PGW, foreign system, and other types of field testing not related to ASE, and 15 percent were applied to internal improvement and modernization efforts to enhance test capabilities and efforts to develop test methodologies for use across the Services.

The Center continued to develop multiple test tools for evaluating ASE infrared countermeasure (IRCM) systems and hostile fire signature (HSIG) database models used to support development of HFI systems. In addition to leading test tool development efforts, the Center also developed an ASE T&E methodology guidebook to provide DoD with guidance for planning, executing, and reporting on ASE test events. The Center dedicates about 6 percent of its efforts to providing subject matter expertise to numerous working groups and task forces.

The following activities are representative of those conducted by the Center during the past year.

ASE AND HSI ACTIVITIES

ROTARY-WING TEST EVENTS

Army: Reduced Optical Signature Emissions Solution VII

- **Sponsor:** Department of the Army Technology Applications Program Office, Systems Integration and Maintenance Office, Aircraft Survivability Equipment Cell
- **Activity:** The Center provided test assets and crew to perform effectiveness testing of flares and flare sequences against reactive captive infrared (IR) missiles. These tests evaluated new CM sequences, variations of current CM sequences using improved flares, or different flares within the sequences. The Army used these data to finalize flare sequences on 160th Special Operations Aviation Regiment rotary-wing aircraft.
- **Benefit:** The outcome of this combined effort resulted in verification of the effectiveness of flare sequences used on aircraft deployed in-theater and under development.

Army: MH-60M Initial Operational Capabilities Testing and Training

- **Sponsor:** Department of the Army Technology Applications Program Office, Systems Integration and Maintenance Office, Aircraft Survivability Equipment Cell
- **Activity:** The Center provided Joint Mobile IRCM Test System (JMITS) simulations, reactive captive IR seekers, and test personnel to conduct integrated testing and aircrew training of the aircraft Common Missile Warning Sensor and IR flare dispensers. The performance of the aircraft's IR flare sequence against reactive captive IR missiles was evaluated along with aircrew training in an electronic warfare (EW) threat environment consisting of the JMITS simulations and radio frequency threats. The Army used these data to finalize flare sequences on 160th Special Operations Aviation Regiment MH-60M rotary-wing aircraft and develop tactics, techniques, and procedures for the aircrews.

- **Benefit:** The outcome of this combined effort resulted in verification of the effectiveness of flare sequences used on MH-60M aircraft and aircrew training in a simulated EW threat environment.

Army: Hostile Fire Indicting System (HFIS) – Army Flight Test 2

- **Sponsor:** U.S. Special Operations Command (USSOCOM), Technology Applications Program Office
- **Activity:** The Center provided a laser system for laser simulations to support a flight data collection event with USSOCOM MH-47 and MH-60 aircraft equipped with the HFIS system at Redstone Arsenal, Alabama.
- **Benefit:** The sponsor used this event to collect background and live fire data from the AN/AAR-57 Common Missile Warning System, AN/AVR-2B Laser Detecting Set, and Helicopter Alert Threat Termination-Acoustics systems installed on representative aircraft.

Navy: Technology Demonstration of the Department of the Navy (DoN) Large Aircraft Infrared Countermeasures (LAIRCM) Interface to the AN/ALE-47 for Smart Dispense and Advanced IR Countermeasure Techniques

- **Sponsor:** Navy Program Executive Officer, Advanced Tactical Aircraft Protection Systems Program Office (PMA 272), and Naval Research Laboratory
- **Activity:** The Center provided JMITS IR stimulations to verify the performance of advanced IRCM techniques and a new interface between the DoN LAIRCM and ALE-47. The Center provided all data collected to the sponsors for their assessments.
- **Benefit:** The data collected from this effort allowed the sponsors to perform early assessments of the new interface between the DoN LAIRCM and ALE-47 for smart dispense techniques. In addition, it allowed the sponsors to assess the performance of the advanced IRCM techniques against reactive IR static threat seekers and modify these advanced IRCM techniques for improved performance.

Navy: Distributed Aperture IR Countermeasures (DAIRCM) MH-60R Test

- **Sponsor:** Naval Research Laboratory
- **Activity:** The Center provided JMITS IR simulations to verify the performance of the DAIRCM jammer against static seekers. The Center provided all JMITS and static seeker data to the sponsor for assessment.
- **Benefit:** The sponsor used the data from this test effort to adjust their jam code, which resulted in better performance against the static seekers.

Navy/Marine Corps: AH-1Z and MV-22 Aircraft Self-Protection Optimization Flight Tests

- **Sponsor:** Naval Surface Warfare Center – Crane Division, with funding from the Aircraft Self-Protection Optimization program
- **Activity:** The Center provided test assets and crew to perform effectiveness testing of flares and flare sequences against reactive captive IR missiles. These tests evaluated new CM sequences, variations of current CM sequences using improved flares, or different flares within the sequences.
- **Benefit:** The sponsors are using the test results on flare sequence effectiveness to enhance the protection of these aircraft against IR Man-Portable Air Defense Systems (MANPADS).

OSD: Rotorcraft Aircraft Survivability Equipment (RASE) Experiment 2012

- **Sponsor:** Assistant Secretary of Defense for Research and Engineering
- **Activity:** The Center served as Experiment Director and radiometric data collector during the RASE 2012 Tower event at the Weapons Survivability Laboratory Remote Test Site, China Lake, California. Fourteen different systems mounted on an SH-60 helicopter installed on a hover stand participated in the experiment.
- **Benefit:** The RASE Experiment is a venue focused on ASE that enhances decision makers' understanding of ASE performance and advances the ASE state-of-the-art testing. The RASE Experiment is expected to improve realism and standardization in the testing of ASE, improve the extent of testing prior to fielding, and provide an opportunity for multiple developers to save costs overall.

FIXED-WING TEST EVENTS

Air Force: LAIRCM Operational Flight Program (OFP)-14X Software Update

- **Sponsor:** 46th Test Wing, Eglin AFB
- **Activity:** The Center provided JMITS missile simulators and crews to perform ultraviolet and two-color IR simulations to collect system response data for assessing the OFP-14X software update. The Air Force conducted the tests at Eglin AFB using a Beechcraft King Air aircraft fitted with a LAIRCM test bed capable of supporting ultraviolet and IR missile warning systems and the Viper™ laser.
- **Benefit:** The testing provided the Air Force with a cost-effective test venue for collecting critical data needed to assess performance of the LAIRCM flight test software prior to installation on the host aircraft.

ROTARY- AND FIXED-WING TEST EVENTS

Air Force, Navy: Advanced Strategic and Tactical IR Expendables

- **Sponsors:** Naval Surface Warfare Center – Crane Division, Air Force Special Operations Command, 46th Test Wing, and Air Mobility Command
- **Activity:** The Center provided test assets and crew to collect test data on eight different aircraft against reactive captive IR missiles. These tests evaluated new flare CM sequences, variations of current flare CM sequences using improved flares, or different flares within the sequences.
- **Benefit:** Sponsors are using these test results on flare sequence effectiveness to enhance the protection of various aircraft against IR MANPADS.

Army: Seeker Bowl VII

- **Sponsors:** U.S. Army Research Development and Engineering Command, Engineer Research and Development Center, and Aviation Applied Technology
- **Activity:** The Center provided test assets and crew to collect test data on flare protection effectiveness for four fixed-wing and two rotary-wing aircraft against reactive captive IR missiles. The test evaluated the effectiveness of new flare CM sequences or variations of current flare CM sequences.
- **Benefit:** Sponsors are using these test results on flare sequence effectiveness to enhance the protection of various aircraft against IR MANPADS.

HOSTILE FIRE INDICATOR (HFI) DATA COLLECTION EVENTS

Army: Hostile Fire Detection System Signature Ammo Study (SAS)

- **Sponsor:** Program Manager – Aircraft Survivability Equipment (PM-ASE)
- **Activity:** The Center provided radiometric equipment and test crews to collect and reduce signature data on small arms (muzzle, hardbody, and tracer) and rockets (eject, boost, and tracer characteristics) on two separate test events, SAS-W and SAS-3.
- **Benefit:** The results from measured data will determine the variability within ammunition types and country of origin. The Center will use the measured data to develop the DOT&E Threat Resource Activity-sponsored HSIG model, which will integrate into T&E Modeling and Simulation facilities and support Hostile Fire Detection System foreign ammunition purchases for test events.

Navy: Trial Oxidizer 1

- **Sponsor:** Naval Research Laboratory
- **Activity:** The Center provided radiometric equipment and test crews to collect and reduce signature data on small arms and anti-aircraft artillery muzzle flash.
- **Benefit:** This was the first international signature collection trial in cooperation with NATO. The Center will share the collected radiometric data on small arms and anti-aircraft artillery among all participants.

NATO: NATO Threat Data Collection Quick Reaction Assessment (QRA) (Trial PROTEUS)

- **Sponsor:** NATO Air Capability Group 3, Sub-Group 2
- **Activity:** The Center provided trial management, radiometric instruments, and crew during the collection of hostile fire threat signatures at the Poček range near Postojna, Slovenia.
- **Benefit:** This activity provided a venue for seven nations to collaborate and test HFI systems for rapid fielding and to collect threat signature data for use in developing hostile fire models.

CM-BASED PRE-DEPLOYMENT TRAINING FOR SERVICE MEMBER EXERCISES

Surface Attack Training – Nellis AFB, Nevada
Angel Thunder – Barry Goldwater, Arizona
Texas Air National Guard Pre-Deployment Training – San Antonio, Texas
Mobility Air Force Exercise – Nellis AFB, Nevada
Mission Employment Exercise – Nellis AFB, Nevada
Apache Block III Technics, Tactics, and Procedures (TTP) Development Support – Fort Irwin, California
Neptune Falcon – Nellis AFB, Nevada
58th Special Operations Wing Training Support – Albuquerque, New Mexico
4th Battalion 501st Aviation Regiment Training Support – Fort Bliss and Houston, Texas
28th Test and Evaluation Squadron Maritime TTP Development – San Diego, California
Joint Readiness Training Center Training Support – Fort Polk, Louisiana
509th Weapons Squadron KC-135 Support – Roswell, New Mexico

- **Sponsors:** Various
- **Purpose:** The Center's equipment and personnel provided a simulated threat/CM environment and subject matter expertise to observe aircraft sensor/ASE systems and crew reactions to this environment. Specifically, the Center emphasized simulated MANPADS engagements for participating aircraft. Additionally, the Center provided MANPADS capabilities and limitations briefings to pilots and crews and conducted "hands-on" training at the end of the briefings.
- **Benefit:** Provides realism to the training threat environment for the pilots and crews to facilitate understanding and use of CM equipment, especially ASE. The Center provided collected data to the trainers for assisting units in the development/refinement of TTPs to enhance survivability.

PGW CM ACTIVITIES

Navy: Joint Stand-Off Weapon (JSOW) System

- **Sponsors:** U.S. Navy, Program Manager, Precision Strike Weapons (PMA 201)
- **Activity:** The Center provided camouflage, concealment, and deception countermeasures for two JSOW missile live-fire drops against stationary land targets. The missile drops consisted of camouflage nets or IR smoke pots supplemented with camouflage nets.
- **Benefit:** Conducted regression testing to determine if the JSOW C-1 mission capability regarding stationary land targets has been retained in an IRCM environment given the recent addition of a moving maritime target capability. The IRCM land target test results will provide data characterizing imaging IR seeker performance, which will be presented at the JSOW C-1 Operational Test Readiness Review in 1QFY13.

National Ground Intelligence Center: Foreign Electro-Optical System (FEOS)

- **Sponsor:** National Ground Intelligence Center
- **Activity:** The Center provided a Paveway III semi-active laser guidance section and personnel to collect and reduce data showing the countermeasure effects caused by the FEOS in a field environment.
- **Benefit:** Collected field test data on the FEOS will help aide the exploitation efforts and evaluate the effects on U.S. domestic guided weapon systems when subjected to this foreign electro-optical countermeasure system.

SURVIVABILITY INITIATIVES

HSIG Model

The Center is leading development of an HSIG model to support HFI T&E and modeling efforts. The HSIG model project is sponsored by the Threat Resource Activity and will develop a physics-based, electro-optical model that produces signatures for the 12.7 mm Armor Piercing Incendiary Tracer round and a rocket-propelled grenade (RPG 7). The Center completed development of the first small arms tracer round and RPG models. Model validation and integration to Navy and Army facilities will take place in FY13.

Aircraft Survivability Equipment (ASE)/Hostile Fire Indicator (HFI) Symposium

The Center held the fourth ASE/HFI symposium and workshop that included current Australian, Canadian, New Zealand, United Kingdom, and U.S. threat detection systems briefings; "break-out" coordination sessions; and continued development of a five-nation methodology for ASE/HFI performance testing. This Center-led initiative provides a venue for cross-Service and international discussion on the common problem of Service member protection from threat missile and ballistic hostile fire in theater. The Center has partnered with the U.S. Naval Postgraduate School to develop an academic certificate of training to participants of future international, classified ASE/HFI T&E Training Symposiums sponsored by the Joint Countermeasures T&E Working Group (JCMT&E WG).

Joint Countermeasures T&E Working Group (JCMT&E WG)

The JCMT&E WG is co-chartered by DOT&E and DASD(DT&E) to improve the integration of:

- Aircraft self-protection developments
- Live weapon-fire T&E
- Operational T&E
- Development of standardized test methodologies
- Common instrumentation and standards

This group includes DOT&E, DASD(DT&E), all four of the U.S. Services, Australia, Canada, New Zealand, the United Kingdom, and NATO Air Force Armaments Group Sub-Group 2, as members of a coalition warfare sub-WG. The group is tasked with actively seeking mutually beneficial T&E opportunities to measure performance and suitability data necessary to provide relevant operational information to deploying joint/coalition Service members and for U.S. acquisition decision makers. Specific efforts included the following:

- The JCMT&E WG developed, coordinated, and implemented an eight-year bilateral ASE Cooperative Test and Evaluation Project Arrangement (CTE PA) and its supporting Project Management Plan (PMP) with the United Kingdom. Nations' defense organizations, ASE Program Offices, DT, OT, and LFT&E agencies will now be able to collaborate on common test equipment and procedures, measure operationally relevant ASE data, and improve Service member survivability.
- The JCMT&E WG completed official negotiations and concluded agreement of a bilateral ASE CTE PA and PMP with Australia to expand U.S. T&E capabilities and cooperation. This coordination resulted in the Center's participation in an Australian hostile fire data collection trial that expanded the U.S. threat database and will improve U.S. HFI threat detection algorithms.
- In support of High-Level NATO Multinational Approaches Initiatives, and DOT&E initiatives to NATO, the Center developed, organized, and conducted a highly successful, seven-nation NATO QRA in Slovenia. U.S. Ambassador Joseph Mussomelli praised the Center for coordination with the Embassy and Slovene Forces, and for its planning and execution of this first U.S.-led NATO QRA in Slovenia.
- The Center coordinated the first Technical Meeting of the Multinational Test and Evaluation Program memorandum of understanding in Ottawa, Canada, to initiate negotiations

of this 10-year agreement between Australia, Canada, New Zealand, the United Kingdom, and the United States.

- In support of NATO sub-group 2 and the Australia, New Zealand, and U.S. agreements, the JCMT&E WG's efforts led to the approval by the Chief of the New Zealand Defence Force to conduct Trial PĀKAI KŌPERE II by SG2 in New Zealand in 2QFY14. The sub-group will ask the Center to provide a Multi-Spectral Sea and Land Test Simulator, IR MANPADS Seeker Test Van, and test personnel to support this effort.

Aircraft Survivability Equipment (ASE) Test and Evaluation (T&E) Methodology Guidebook

The Center created an ASE T&E Methodology Guidebook to provide the DoD with guidance for planning, executing, and reporting on ASE systems' test events. The ASE systems addressed in this guidebook include IRCM, ultraviolet, IR passive missile warning systems, HFI, and Laser Warning Receiver systems.

Program managers and T&E leads should use the guidebook to better understand the process their teams follow, ensure that testing is being conducted using good test objectives, and ensure that the data gathered to evaluate those objectives are valid. Such a guide is especially critical for program managers and test managers/leads new to ASE testing. This guidebook provides suggested processes and procedures for collecting test data, as well as suggested data formats and data products for presenting test data to aid the T&E community in achieving consistency and setting expectations.

Both DOT&E and DASD(DT&E) endorsed the ASE T&E Methodology. As the ASE T&E community converges on common test methodologies and approaches, programs can achieve efficiencies and savings by utilizing common test and range infrastructure, common models and simulation tools, and the ability to share threat weapon data.

Helicopter Survivability Task Force

The Center is participating with the Assistant Secretary of Defense for Research and Engineering to increase aircraft survivability by coordinating Research and Development activities and JCMT&E WG initiatives using tailored projects for DoD programs of record and out-of-cycle emergent Service member projects.

THREAT SIMULATOR TEST AND EVALUATION TOOLS

The Center, in conjunction with the Test Resource Management Center, is nearing completion of the IRCM Test Resource Requirements Study (ITRRS) "refresh." The end product from this effort will be an updated roadmap of prioritized projects necessary to perform T&E of advanced IRCM and HFI systems. The Center completed the original ITRRS roadmap in 2007, which led to several projects being funded by the Central Test and Evaluation Investment Program to fill the identified IRCM T&E gaps. Each product will have a functional description of the project; the priority is based upon Program of Record test schedules, requirements, and Service input.

The Center has continued to develop tools for T&E of IRCM systems funded by the USD(AT&L) Test Resource Management Center, Central Test and Evaluation Investment Program. Currently, the Center is leading the development of the Multi-Spectral Sea and Land Test Simulator (MSALTS) and the Joint Standard Instrumentation Suite (JSIS).

- The MSALTS is a small, mobile missile simulator that can fire while moving and simulate all current tier-one missile threats. The Center has designed the MSALTS to provide simulated signatures for the new and more capable missile warning systems, such as LAIRCM Next Generation, DoN LAIRCM, and Joint and Allied Threat Awareness System. The Center initiated development of the first two systems in September 2011. The Center completed fabrication, assembly, and checkout of most hardware items in FY12; four of eight software builds completed in FY12. Developers plan to execute Government acceptance testing of these MSALTS systems in September 2013.
- The Center has completed a preliminary concept and development plan for the JSIS. The Center intends JSIS to be a comprehensive, turnkey instrumentation package that can be used during hostile fire testing and MANPADS firing events in and outside the U.S. to support model development and validation. The JSIS will provide calibrated signature measurements for T&E (thus enhancing test adequacy) and post-test anomaly resolution. The Center will archive all the data that it collects using JSIS and make them available to the Services for current and future IRCM programs. The Center is actively pursuing JSIS sponsorship via the Central Test and Evaluation Investment Program. In the spring of 2012, the Helicopter Survivability Task Force initiative provided funding to develop equipment that will measure hostile fire munitions' time-space-position information, and ultraviolet signatures. The Services will field this equipment in FY13, fulfilling an immediate JSIS development need.

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