Live Fire Test and Evaluation Program

DOT&E executed oversight of survivability and lethality test and evaluation for 117 acquisition programs in FY10. Of those 117 programs, 19 programs 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.

LFT&E published the following special reports during the past year:

- Assessment of the Mine Resistant Ambush Protected (MRAP) Family of Vehicles
- Operational and Live Fire Report of the M915A5 Truck Tractor, Line Haul
- Live Fire and Operational Test and Evaluation Report on the Mine Resistant Ambush Protected (MRAP) – All Terrain Vehicle (M-ATV)
- Hard Body Armor Phase II and Phase II Follow-on Test and Evaluation, DOT&E Independent Assessment

DOT&E published the following combined OT&E/LFT&E reports on acquisition programs entering full-rate production:

- *Virginia* Class Submarine
- USS *San Antonio* (LPD 17) Amphibious Transport Dock Ship
- Littoral Combat Ship (LCS) 1
- USMC H-1 Upgrades (AH-1Z)
- C-5M

In addition to satisfying acquisition program 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), 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, (Joint Live Fire). LFT&E investment programs also support quick reaction efforts aimed at 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 assure development of consistent, credible effectiveness estimates for conventional munitions across the DoD. The JTCG/ME develops the Joint Effectiveness Manuals (JMEM), that are the sole source for all authenticated non-nuclear weapons effectiveness data within the DoD. The primary application of the JMEM is to support weaponeering, defined as the detailed technical planning of a weapon strike that occurs at multiple levels in the operational chain of command before actual combat. The JTCG/ME produces, distributes, and regularly updates JMEMs. JMEMs provide computerized operational tools and data for rapid evaluation of using alternative weapons against specific targets. In many cases, collateral damage estimates generated by these tools are part of the decision criteria for strike missions. In FY10, the JTCG/ME developed and released two updated JMEMs.

The first updated product is the JMEM Weaponeering System (JWS) version 2.0.1, which is a combination of both Air-to-Surface and Surface-to-Surface weapons effectiveness data. It includes target vulnerability information for approximately 1,500 targets, descriptive information, data, graphics, computer programs, and methods needed to accomplish weaponeering, step-by-step training guides for weaponeering, and related Help files. JWS provides the capability to evaluate the effectiveness of various air-to-surface and surface-to-surface weapons against a variety of target types. JWS includes solutions on over 250 new or updated targets from the previous edition. The JTCG/ME continued direct support to the Joint Staff "No-Strike and The Collateral Damage Estimation Methodology" process by publishing an updated set of Collateral Effect Radii tables. The JTCG/ME provided data updates concurrent with deployment of rapidly fielded weapon systems supporting current operations in the Central Command (CENTCOM) Area of Responsibility.

The second updated product released by JTCG/ME during FY10 is the Joint Anti-Air Combat Effectiveness (J-ACE) System version 4.1, which includes the Joint Anti-Air Model. J-ACE incorporates 16 new threat models for enemy air-to-air and surface-to-air missiles. The model also performs checks for maximum off-boresight launch angle limits. Additionally, J-ACE contains updates on the weapon engagement zone, (launch control), effectiveness data for seven U.S. systems and various architectural and graphical user interface improvements.

This JMEM is used by fighter pilots to develop air superiority tactics and by U.S. Strategic Command for global strike mission planning.

The JTCG/ME continued efforts to support the integration of Information Operations tools into the JMEM format. These efforts, performed in coordination with the U. S. Strategic Command and others, resulted in enhancements to Computer Network Operations, Electronic Warfare, and various Psychological Operations tools. Information Operations training was also conducted at numerous locations. Initiatives related to JMEM development for other non-traditional effects (e.g., non-lethal weapons, high-energy lasers, high power microwave weapons) continued.

JOINT AIRCRAFT SURVIVABILITY PROGRAM (JASP)

DOT&E sponsors and funds the Joint Aircraft Survivability Program (JASP). 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. The mission of JASP is to increase the readiness and effectiveness of U.S. military aircraft through the joint coordination and development of survivability techniques, technology, and assessment methods. The program funds analyses and technology development projects. JASP also funds the Joint Combat Assessment Team (JCAT), which is deployed to the CENTCOM theater and uses data gathered from combat, threat exploitation, and LFT&E to provide combat commanders support for mission planning and developing operational tactics.

In FY10, JASP worked with the Office of the Under Secretary of Defense (OUSD) Acquisition Technology and Logistics/ Deputy Director Research and Engineering (AT&L/DDR&E) and DOT&E on the DDR&E-led Helicopter Survivability Task Force (HSTF). The multi-disciplinary team was tasked with rapidly fielding techniques and technology to improve helicopter survivability in Operation Enduring Freedom. JASP led the Study on Rotorcraft Survivability, completed and delivered to Congress on October 2, 2009, and focused the HSTF effort on addressing the leading causes of DoD helicopter losses. JASP provided expertise on aircraft survivability, especially vulnerability reduction technology. JASP recommended two specific vulnerability reduction technologies for funding: Firetrace™ passive fire protection for the V-22 main landing gear bay, and multi-hit transparent armor for the down look window in the MH-47G cockpit door. Congress provided funding for the Firetrace™ installation on the V-22, and fielding is expected to begin in the first quarter of FY11. While funding for fielding transparent armor in the MH-47G down-look window is pending, interest in the transparent armor for other helicopter applications is growing.

JASP funded 47-multiyear survivability projects for $9.7 Million and reported results of 29 projects in FY10. The following summaries illustrate current JASP efforts in four focus areas: susceptibility reduction, vulnerability reduction, survivability assessment, and combat damage assessment.

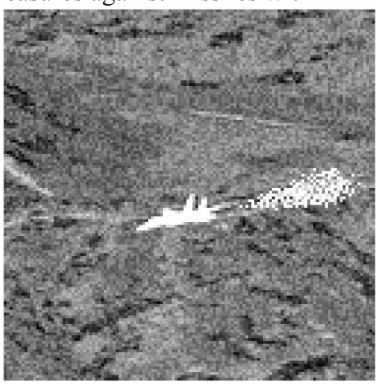
Susceptibility Reduction

JASP continues projects in susceptibility reduction science and technology efforts. These efforts address urgent aircraft survivability needs emerging from Operations Iraqi Freedom, Enduring Freedom, and New Dawn, as well as improving aircraft survivability against future threats.

Correlation of Seeker Test Van Data with Intelligence

The Naval Air Warfare Center, Weapons Division, China Lake, California, discovered discrepancies between flight test results and intelligence estimates of the performance of seekers in Man Portable Air Defense Systems (MANPADS). These discrepancies have significant implications regarding the proper interpretation of test results and their implications for coalition force survivability and implementation of tactics, engagement doctrine, and countermeasure deployment against Infrared (IR) guided MANPADS. A web-hosted common database was established by JASP at the Missile Systems Intelligence Center incorporating corrections to these discrepancies. In addition, recommendations for standardizing test procedures and data sets were provided to test agencies. The JASP-sponsored investigation of these discrepancies and recommended solutions will assure accurate seeker effectiveness assessments are provided to aircrews and commanders.

Imaging Infrared Seeker Countermeasures



This project develops countermeasures against missiles with advanced Imaging Infrared (IIR) seekers. In FY10, this project used digital modeling and simulation (M&S) to develop several promising countermeasures techniques. JASP supported the IIR Countermeasures Future Naval Capability program to counter IIR seekers. Techniques have now been developed that are ready for verification using hardware-in-the-loop facilities.

Enabling Technologies for Future IRCM Systems

This project funds enabling technologies for future infrared countermeasures (IRCM) systems such as the Common Infrared Countermeasures program. JASP supported the development of

Spinel (a rugged crystal of magnesium aluminum oxide) domes for turrets in IRCM systems, enhancing their reliability and performance against MANPADS. The laser bandwidth capability of IRCM systems was expanded by building, testing, and demonstrating an IR fiber wavelength converter. JASP is sponsoring the design, fabrication, test, and demonstration of anti-reflective surfaces on the ends of IR fibers to significantly improve laser transmission.

Advanced Techniques for Radio Frequency Countermeasures

This project supports the development and testing of countermeasures techniques to increase the survivability of Army, Navy, and Air Force rotary wing aircraft. The project is assessing the ability of an on-board radar warning receiver to receive, process, and display each mode of selected threat weapon systems. The results of the assessments are then used to develop countermeasures techniques and demonstrate their effectiveness against state-of-the-art threat radar weapon systems. In FY10, techniques were successfully demonstrated against two threat radars and are being transitioned to fielded helicopter radar warning and radar countermeasures equipment.

Developed Common Exciter Advanced Suppressor Exercise and Demonstration

This project funded development and testing of new electronic attack techniques against radars with significant electronic protection capabilities. The techniques developed are included in the performance specification for the AN/ALQ-214 Integrated Defensive Electronic Countermeasure system, as well as the EA-18G Next Generation Jammer.

WeaponWatch® Hostile Fire Determination

JASP is supporting the expansion of the current WeaponWatch® hostile intent determination system to include algorithms for detecting attacks by small arms, rocket propelled grenades, and rockets. System performance was successfully demonstrated in a large-scale live-fire field test event held in May 2010, providing algorithms that can be incorporated in systems used to identify hostile fire.

Acoustic Hostile Fire Detection

This project supports the acoustic component of the U.S. Special Operations Command (USSOCOM) multi-spectral Hostile Fire Indicating System (HFIS). JASP is funding requirements definition, analysis of optimum acoustics, sensor location, the number of sensors needed, and installation of prototypes on a demonstration helicopter, as well as ground and flight testing.

Vulnerability Reduction

In FY10, JASP continued to focus on developing lighter-weight opaque and transparent ballistic protection systems, fuel containment technologies for fuel system components, and fire protection technologies.

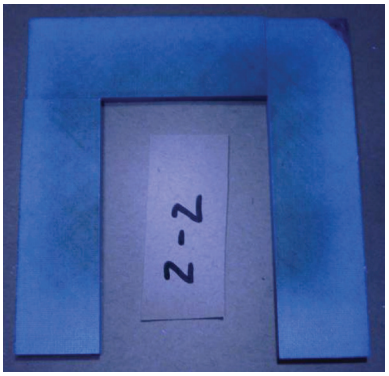
Multi-Hit Transparent Armor

JASP, along with the U.S. Army Aviation Applied Technology Directorate and The Protective Group, Inc. (TPG), developed a transparent armor concept for aircraft that reduced areal density and thickness by 20 percent while improving multiple-hit performance and see-through visibility. Specifically, TPG developed a prototype MH-47G helicopter down-look window with three times the viewing area of the current window that is 17 percent lighter and provides greater ballistic protection and multi-hit visibility.

Critical Component Armor

JASP is developing critical component protection using lightweight, structurally integrated armored panels. JASP is exploring the use of rapid, low-cost ceramic and metal forming processes to integrate armor into aircraft exterior panels, mechanical frames, and structure. This project expects to produce an integrated armored panel capable of passing air worthiness release and defeating prevalent ballistic threats.

Joint Thermal Degradation of Composites



This project funded an effort to quantify the degradation of aircraft structural composite materials as a function of the thermal flux caused by short-lived fuel fires. Under this project, the ability of various Non-Destructive Inspection (NDI) techniques to detect equivalent measures of thermal degradation was assessed. The project expanded the understanding of thermal damage to graphite composites commonly used in fixed and rotary wing aircraft and demonstrated the ability of NDI to determine the magnitude of thermal damage from brief dry bay fires. NAVAIR is currently transitioning procedures to maintenance depots and Fleet Readiness Centers for use in making repair decisions on the F/A-18D/E/F, AV-8B, and V-22 aircraft.

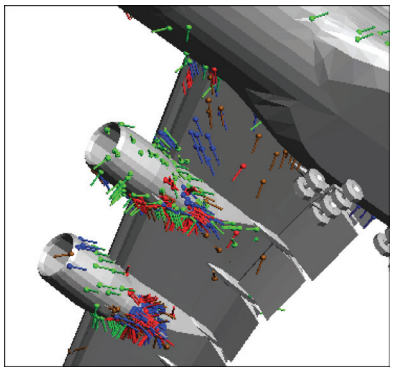
Wireless Fire Detector

JASP continued to fund development of wireless fire detector technology for application in current and future aircraft. JASP is leveraging this Air Force Small Business Innovative Research (SBIR)-led project with the goal of producing a low-cost, lightweight, fast-acting, and reliable fire protection system that is easy to retrofit into fielded aircraft. In FY10, three SBIR contracts were awarded to develop prototype wireless fire detector systems. Fire detection tests of the prototypes in simulated aircraft dry bays began in late FY10 and will continue into FY11. The project will finish in FY11 with environmental testing, final demonstration/validation testing, and limited flight testing on an F-16C at the Air National Guard Command Test Center.

High Performance Fuel Bladder

JASP is working with the METSS Corporation to develop a cost-effective fuel bladder that is 50 percent lighter than current tanks while maintaining adequate ballistic protection. The approach uses an exoskeleton design that reduces the number of fabric reinforcing plies, and a high-performance synthetic sealant that is one-fourth as dense as the natural gum rubber used in existing bladders. In FY10, METSS completed design verification testing including crash impact, gunfire, and panel testing. In FY11, the team will work with the U.S. Army Aviation Engineering Directorate on approved designs and procurement plans for two AH-64 Apache helicopter lightweight fuel bladders, including qualification testing to meet appropriate military specifications.

Improved MANPADS Hit Point Prediction

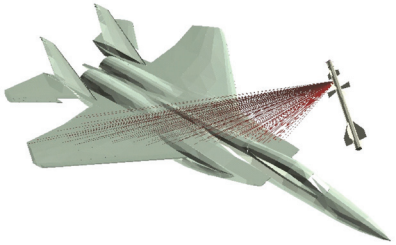


JASP continues to address the issue of hit point prediction to support aircraft vulnerability analyses, design, and LFT&E. The vulnerability of aircraft to MANPADS is highly dependent on hit point, which cannot currently be reliably predicted or modeled. In FY10, three independent DoD MANPADS engagement M&S facilities modeled specific MANPADS threats. A statistical comparison of the results and an analysis to validate MANPADS hit point prediction simulations was conducted. In FY11, the team will complete correlation of M&S hit point prediction test results with available live fire data, and develop a standardized methodology for hit point prediction simulations, improving MANPADS vulnerability analyses.

Survivability Assessment

JASP continues to establish projects designed to develop aircraft survivability assessment methodologies, spanning the engineering level through the engagement level. These methodologies are often used to generate pre-test predictions for LFT&E and OT&E activities.

Vulnerability Toolkit



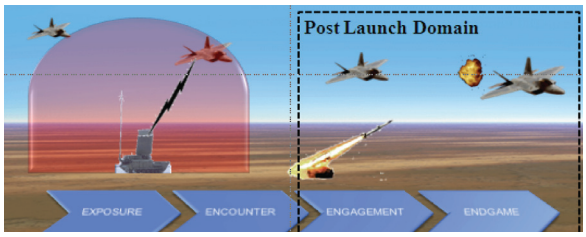
This project developed and documented standard means for characterizing threats used in performing vulnerability analyses. The project included improvements that enable detailed endgame analysis without the need for using simplified, and subsequently less accurate, approximations of targets or threats. In the future, all JASP-sponsored vulnerability assessment data and methods will use standard inputs, significantly improving user support and configuration management.

Crew and Passenger Survivability Methodology

JASP identified two potential methodologies for the assessment of crew and passenger casualties in combat. Both methodologies will be exercised to evaluate their strengths and weaknesses. The first method integrates casualty assessment models within standard vulnerability analysis tools taking into account vulnerability, crash conditions, crashworthiness, and egress capabilities to provide an assessment of crashworthiness. The second method applies discrete crew and passenger expected survivability values to the output of standard vulnerability analysis tools. A workshop of subject matter experts from all Services, NASA, and industry identified the data and models available to support the demonstrations in FY11, as well as the long-term data and modeling needs.

Suite of Anti-air Kill chain – Models and Data

This is a joint project between the JASP, JTCG/ME, and the U.S. Strategic Command (USSTRATCOM). The Suite of Anti-air Kill chain – Models and Data (SAK-MD) effort intends to provide a comprehensive and consistent set of models and data so that all friendly and threat systems are assessed with equal fidelity across the entire kill chain. The SAK-MD project will provide a set of analysis tools that will allow USSTRATCOM to evaluate different scenarios for the delivery of strategic weapons.



Combat Damage Assessment

JASP continued to support the Joint Combat Assessment Team (JCAT) in FY10. JCAT is a team of Air Force, Army, Marine Corps, and Navy personnel deployed in support of Operations Iraqi Freedom, Enduring Freedom, and New Dawn. JCAT forward locations in Iraq were closed down as OIF drew to an end. Conversely, JCAT expanded its operation in Afghanistan, establishing full-time deployments at Bagram, Kandahar, and Camp Bastion.

JCAT efforts include inspecting damaged and destroyed aircraft, acquiring available maintenance documentation, and conducting interviews with aircrew and intelligence personnel. Consultation is provided to weapons, tactics, and logistics personnel and comprehensive briefings are given to commanders in charge of daily air operations. These efforts provide valuable information to commanders allowing them to adjust their tactics, techniques, and procedures based on accurate threat assessments. These efforts, including forward deployments in Iraq and Afghanistan, resulted in the completion of 186 aircraft incident evaluations and reports as of September 25, 2010.

The Army component of JCAT provided deployed commanders with a reporting link accessible via the U. S. Army Aviation Center of Excellence web site. This link will expedite timely battle damage reporting and feeds the Combat Damage Incident Reporting System (CDIRS) hosted by the Survivability/ Vulnerability Information Analysis Center (SURVIAC). This SURVIAC database is the repository for all U.S. aircraft battle damage events.

JCAT provides professional training to the U.S. aviation community. Air Force JCAT members hosted the 2010 Threat Weapons and Effects Seminar at Eglin AFB, Florida. Attendees included representatives of the U.S. Military Services, Department of State, Department of Homeland Security, Federal Aviation Administration, Department of Energy, Federal Bureau of Investigation, and the Bureau of Alcohol, Tobacco, Firearms and Explosives, and U.S. industry partners. JCAT also provides resources such as capabilities briefs, intelligence updates, recent "shoot-down" briefs to discuss enemy tactics, techniques, and procedures, and combat damage collection and reporting.

JOINT LIVE FIRE

Aircraft Systems Program

The goal of the Joint Live Fire Aircraft Systems Program (JLF-Air) is to identify vulnerable areas in current aircraft platforms, understand damage mechanisms, and provide this information to survivability engineers. Since the Vietnam War, there have been great strides in reducing the vulnerability of our aviation platforms. Many of our current helicopters and planes are tolerant to impacts from small arms fire and even some air defense artillery. Unfortunately, as the protection of our aircraft improved, hostile forces have been able to access increasingly lethal MANPADS weapons. These weapons will be present in current and future operational areas; the current challenge is reducing our vulnerability to this threat. As such, a primary emphasis in FY10 was to increase our understanding of lethality and damage mechanisms of MANPADS. In 2009, Army, Navy, and Air Force members of JLF, JASP, and JTCG/ME collaborated to identify and draft a plan, known as the MANPADS Roadmap, to resolve key deficiencies in available MANPADS threat data.

MANPADS Threat Model Development – Blast

This project is collecting data of sufficient accuracy and precision to improve the MANPADS threat models used in aircraft vulnerability assessment codes such as the Computation of Vulnerable Area Tool (COVART) and the Advanced Joint Effectiveness Model (AJEM), as well as damage prediction and assessment tools such as LS-DYNA and the Combat Assessment Tool (CAT). JLF-Air is coordinating test events with modelers to ensure the necessary data is being captured. During initial tests in September 2010, JLF-Air successfully collected static and dynamic blast pressure data. JLF-Air plans additional static tests for early FY11.

Large Engine Vulnerability to MANPADS

The goal of this project is to determine the vulnerability of a large turbofan engine to a MANPADS threat as an initial step in understanding the vulnerability of large multi-engine aircraft. JLF-Air is performing this project in partnership with the Department of Homeland Security, Aircraft Systems Program, which is providing matching funds. NASA is also partnering on this project. Two MANPADS will be shot into operating CF6-50 engines to investigate engine-nacelle fires, uncontained engine debris, and the ability to maintain controlled

flight and safely land with damaged engines and airframes. The CF6-50 is representative of engines found on the A300, B747, and KC-10 aircraft and will be tested using realistic power settings, airflow, MANPADS impact velocity, detonation conditions, and shotlines. NASA will conduct a combination of wind tunnel tests and simulations to estimate the effects of damage on aircraft safety of flight. JLF-Air FY10 efforts focused on fabrication of the engine test stand and getting the CF6-50 engines operational. This work will result in a better understanding of the role of engine vulnerability on overall aircraft vulnerability.

MANPADS Comparative Analysis

This project compared the physical and performance characteristics of newer, widely proliferated MANPADS to identify a standard LFT&E test article that could be used to represent later generation missiles for future live fire tests. This hybrid missile would be used in lieu of the typically hard to obtain actual threat weapons. The standardized configuration will lead to higher fidelity characterization and improved live fire testing by better representation of MANPADS across programs.

Dry Bay Fire Vulnerability

This project is evaluating the use of passive fire extinguishing technologies to reduce aircraft vulnerability to fires in dry bays. In FY10, twelve test events were successfully completed, demonstrating potential solutions for the wing leading edge dry bays in the Joint Cargo Aircraft. In FY11, testing will examine solutions for the wing trailing edge dry bays.

Combat Incident Emerging Threat Investigation

A recent combat incident in Afghanistan raised concerns about a potential new threat to helicopters. In this incident, a CH-47 helicopter was damaged in a manner uncharacteristic of any previous aircraft incident, and the JCAT requested JLF-Air help to provide threat characterization data to support their assessment. Having data from controlled live fire tests to compare to the damage was a high priority for JCAT.

JLF-Air conducted two shots to collect initial damage effects data against surrogate airframes using static detonation of the "legacy" threat and dynamic impacts with the postulated "new" threat. Shotlines, based upon information provided by JCAT, addressed basic suspected damage results.

Comparable tests will be executed in FY11 with both static and dynamic warhead impacts against actual CH-47D Chinook airframes. The data collected will be provided to the JCAT, JASP vulnerability reduction community, the National Ground Intelligence Center, and threat modeling communities.

Ground Systems Programs

The goal of the Joint Live Fire Ground Systems Program (JLF-Ground), previously known as the Armor/Anti-Armor program, is to fully characterize current threat weapons and munitions, providing critical empirical data to Joint Improvised Explosive Defeat Organization (JIEDDO) and JTCG/ME. The program also addresses combat personnel protection and survivability from threat weapons. The program funds projects to improve the understanding of weapons effects during operations in urban environments.

Ballistic Clay Development for Use as Body Armor Test Backing Material

In an effort to better characterize and reduce uncertainties in body armor testing, a joint effort between DOT&E, the Services, academia, and industry is underway to produce a consistent, well-documented clay formulation designed specifically for ballistic testing of body armor at room temperature. The project intends to introduce the new ballistic clay into personal protection equipment (PPE) testing in FY12. Results are being shared with Government and commercial stakeholders.

X-ray Fragment Characterization System Testing & Optimized Fragment Recovery Media Study

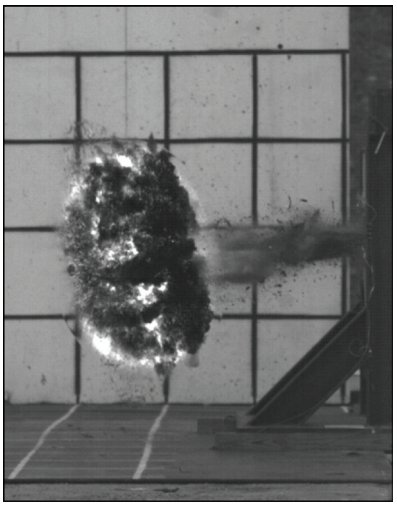
In FY09, JLF-Ground began an effort to improve DoD's capabilities in performing arena testing and warhead assessments. The FY10 effort focuses on two areas. The first assesses the capability of high-power X-ray systems to significantly automate portions of the process by providing higher quality data while reducing cost and time requirements. The second assesses new materials for capturing fragments to provide better velocity assessments while simultaneously reducing cost. Initial results indicate the potential of using X-ray systems, but analysis of results is still underway to determine the accuracy of such systems.

Surface-Laid Improved Explosive Device (IED) Characterization

JLF-Ground is conducting additional characterization tests of the OF-540 artillery round in a theater representative surface-laid configuration, specifically measuring at a higher distance above the ground. The data obtained from this testing will be used to further characterize surface-laid IEDs to be used in M&S of

IED engagements against taller ground vehicles. Testing will be continued in FY11.

Shoulder-Fired Munition Wall Damage Characterization Tests



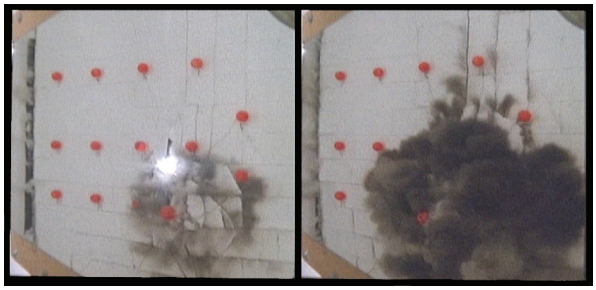
This project performed tests of tandem warheads against three strengths of triple brick walls. The tests investigated the influence of wall target strength on the performance of precursor/bash-through designs for shoulder-fired munitions under development. Data obtained from the tests will allow improvement in lethality/vulnerability assessments of munitions and the development of a computational tool that will model both the precursor and follow-through warhead effects on the target. Data from these tests will also give operational commanders better information on weapon effectiveness against targets in theater by including a wide variation of brick strengths in the target set.

High-Explosive/Fragmentation Mortar Round Characterization

This project funds tests characterizing blast overpressure and fragmentation produced by the O-832 High Explosive/Fragmentation (HE/FRAG) series mortar round that insurgents use in theater. The data collected will provide threat information to be used to support analysis of troop vulnerability to the round, as well as countering its effectiveness.

Venting Effects on Quasi-Static Pressure

Conduct of Military Operations in Urban Terrain (MOUT) requires that operators estimate the damage to typical urban structures caused by weapons. This is vital for both the estimation of risk to Soldiers as well as estimating the effectiveness of munitions in urban combat. In this project, tests were performed to characterize airblast propagation and structural response from detonations within special target structures. The U.S. Army Research Laboratory (ARL) investigated the effect of window and doorway position on internal quasi-static pressures. Additionally, the Air Force Research Laboratory, with the Defense Threat Reduction Agency, conducted specialized tests of airblast propagation through failing walls. Data from these experiments are being provided to modelers to produce improved predictive methods for MOUT scenarios.



Improving HEI Lethality and Vulnerability Products for Tri-Service Applications

This project conducted tests to characterize the fuze and warhead characteristics of the 23 by 152 mm high explosive incendiary (HEI) projectile. ARL collected data from threat rounds impacting aluminum and steel target coupons representing typical aircraft skin and conventional plate armor, respectively. The data will be used to provide lethality assessments for weapons users based on accurate penetration and detonation of HEI projectiles against ground mobile targets and aircraft with added ballistic protection.

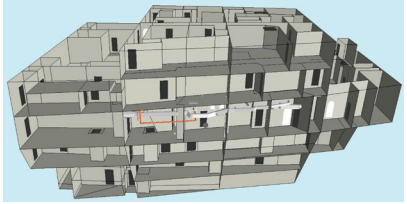
Sea Systems Program

The Joint Live Fire Sea Systems Program (JLF-Sea) made significant progress in FY10 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. Naval vessels.

Finnish Fast Attack Craft Testing

FY10 was the second year of a multi-year, 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. The German and U.S. Navies provided instrumentation, test planning, M&S, and analysis. The objective is to understand the behavior of aluminum structures subjected to various weapon effects. In FY10, underwater explosion testing and air explosion testing was conducted including shaped charge weapons. The ongoing validation of analytical tools for these applications is a primary objective. These tests will help in understanding the weapons effects against aluminum ships, and will augment the LFT&E programs for Joint High Speed Vessel and the Littoral Combat Ship.

Network Fire Model Enhancements



This project provided funds to further develop the U.S. Naval Research Laboratory (NRL) Fire and

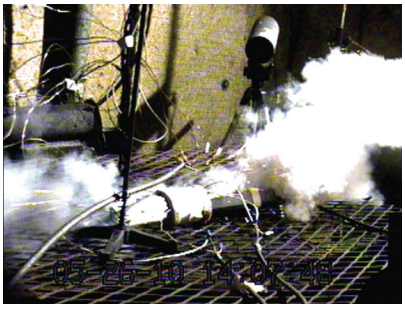
Smoke Simulator (FSSIM) model. The model can be used by naval engineers to develop ship designs that limit the spread of fire and smoke. NRL added features to allow the user to modify compartment fuel loadings to assist in understanding changes to a ship's general arrangement, and to allow the incorporation of non-traditional Navy ship structural materials, such as aluminum, into FSSIM models, leading to improved evaluations of ship survivability.

Submarine Susceptibility to Mines

This project will improve the Navy's ability to assess the susceptibility and vulnerability of submarines to threat mines. In September 2010, small-scale testing was conducted to acquire validation data to assess the underwater explosion resistance of a submarine pressure hull to a bulk charge detonation under the keel of the submarine. Remaining efforts will focus on analysis and construction of relevant test scenarios for vulnerability evaluation. These tests will help validate M&S tools, which can be used to understand the effects of mine blasts on submarines.

Lithium Battery Vulnerability

This project is characterizing the reaction of lithium and lithium-ion batteries to misuse in handling and environmental conditions. Testing was used to identify the type of reaction, burning characteristics, and heat release rate associated with exposing the batteries to dropping, heat, and fire. The results are being used as inputs to the design and development of a prototype battery condition monitoring and protection system. These tests will provide more accurate assessments of the vulnerabilities of ships and submarines that carry and use lithium or lithium-ion batteries.



Diesel Submarine Underwater Explosion Testing

The U.S. and German Navies initiated a project agreement in 2009 to continue development and validation of simulation tools for assessing ship survivability to various explosive threats. The current agreement involves the testing of a decommissioned U206 submarine in the Baltic Sea. JLF provided funding to add a test of a submarine resting on the sea floor – a typically hard to detect position. This effectively leverages a joint U.S./German investment of nearly $17 Million and provides data to increase the fidelity of models and the accuracy of survivability assessments for a situation for which little data are currently available.

SPECIAL INTEREST PROGRAMS

Active Protection Systems (APS)

In response to FY08 legislation, DOT&E continues to direct testing of active protection systems with the potential of protecting wheeled tactical vehicles. Presently six foreign and domestic manufacturers (two foreign, two domestic, and two combined foreign/domestic) are participating in this program. Testing will continue through 2QFY11. Upon completion, DOT&E will provide reports to Congress and acquisition leadership. This effort will determine the capabilities of current active protection system technology and guide future acquisition decisions related to land, air, and sea RPG protection.

Personnel Protection Equipment

DOT&E continued oversight of testing personnel protection equipment. DOT&E provided its report to Congress in July 2010 on the results of the Army's extended ballistic testing of hard body armor plates conducted by the Army Test & Evaluation Command from February through October 2009. This report closed the action generated by House Armed Services Committee hearings June 2007 requiring DoD to "perform additional comprehensive first article ballistic testing" of body armor systems. The purpose of this extended testing was to rigorously characterize the performance of plates that had previously passed First Article Test and been accepted by the government. The testing also provided empirical data to improve body armor test protocol.

DOT&E, in partnership with the Services and the U.S. Special Operations Command (USSOCOM), developed a new testing protocol for ceramic ballistic plates. It ensures the body armor provided to Service members meets ballistic protection requirements and provides uniform protection on the battlefield. Based on data obtained during the Army's extended testing, this protocol established a DoD-wide standard for testing body armor ballistic inserts. The protocol relies on rigorous statistical measures of performance.

The National Academy of Sciences' Committee to Review the Testing of Body Armor Materials for Use by the U.S. Army continued its independent review of tests conducted at Aberdeen Test Center that were the subject of a 2009 Government Accountability Office review. DOT&E, the Army Test & Evaluation Command, USSOCOM, and other interested organizations supported multiple data-gathering meetings by providing briefings, demonstrations, and range orientations to the members of the study committee. The Committee provided

two interim reports. The first report, delivered in January 2010, provided recommendations on the use of the laser measuring instruments and clay backing material used in body armor testing. The second report, delivered in May 2010, provided recommendations for improving the ballistic clay used in hard body armor testing to determine possible replacements for clay in testing, and to implement statistically-based protocols. DOT&E provided these interim reports to Congress. DOT&E sponsored a program review issue that obtained the additional funding required for the Army to implement these recommendations, as well as other recommendations made by the National Institute of Standards and Technology to improve measurement accuracy during testing.

Enhanced Combat Helmet

The U.S. Marine Corps and Army conducted developmental testing of the Enhanced Combat Helmet during 2010. This program seeks to increase ballistic protection for Service members while maintaining weight equivalent to the Army's currently fielded Advanced Combat Helmet. Successful helmet designs will undergo more rigorous testing in FY11 prior to fielding, while any new designs will start developmental testing. DOT&E, working with the Services and the USSOCOM, is also preparing a DoD-wide standard for testing of military combat helmets.