Live Fire Test and Evaluation Program

DOT&E executed oversight of survivability and lethality test and evaluation for 118 acquisition programs in FY11. Of those 118 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.

DOT&E published LFT&E reports on the following program during the past year:

- Medium Tactical Vehicle Replacement (MTVR) Family of Vehicles (FoV)
- Mine Resistant Ambush Protected (MRAP) – All Terrain Vehicle (M-ATV) Underbody Improvement Kit (UIK)

DOT&E published special reports regarding LFT&E on the following programs during the past year:

- M855A1 Lead-Free, 5.56 mm Cartridge
- Protocols on Military Combat Helmet Standards for Ballistic Testing
- High Mobility Multi-purpose Wheeled Vehicle (HMMWV) Expanded Capacity Vehicle (ECV) Family of Vehicles (FoV)
- Special Operations Forces (SOF) Mine Resistant Ambush Protected – All Terrain Vehicle (M-ATV)
- MRAP Force Protection Industries Cougar A1 and A2 Independent Suspension System (ISS) Vehicles
- Stryker Double-V Hull (DVH) Infantry Carrier Vehicle (ICV)

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

- C-27J Joint Cargo Aircraft
- Excalibur Increment 1A-2
- C-5 Reliability Enhancement and Re-Engining Program

DOT&E also published a combined Early Fielding Report on the Precision Lethality Mark 82 (MK 82) Bomb and a combined FOT&E Report on the MH-60R Multi-Mission Helicopter and MH-60S Multi-Mission Combat Support Helicopter.

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 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). 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 ensure development of consistent, credible effectiveness estimates for conventional munitions across the DoD. DOT&E oversees the JTCG/ME and provides funding. The JTCG / ME produces and distributes this 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 operational tools and data for rapid evaluation of alternative weapons and their delivery against specific targets. In many cases, collateral damage estimates generated by these tools are part of the decision criteria for strikes approved at the highest levels of the U.S. Government.

In FY11, the JTCG/ME published two updated JMEMs. The first was the JMEM Weaponeering System (JWS) v2.1 for use with air-to-surface and surface-to-surface weapons. In addition to weapons effectiveness data, JWS includes target vulnerability information for approximately 1,500 targets, including descriptive information, data, and graphics; computer programs and methods needed to accomplish weaponeering; step-by-step training guides, and help files. A major upgrade in JWS v2.1 is the Fast Integrated Structural Tool, requested by U.S. Central and Pacific Commands to enable modeling buildings, bunkers, and tunnels rapidly, within a single program for time sensitive strike evaluation. The JTCG/ME continued to provided direct support to the Joint Staff "No-Strike and The Collateral Damage Estimation Methodology" process, publishing updates to the set of collateral effect radii (CER) tables. Both the JWS software and the CER tables were used extensively during U.S. Africa Command's Odyssey Dawn in support of international military operation in Libya. JTCG/ME also accredited a new collateral damage estimation tool for operational use, which displays collateral damage effective radii reference tables for quick evaluation of potential effects in a target area.

The second JMEM published in FY11 was the Joint Anti-Air Combat Effectiveness (J-ACE) v5.0. J-ACE contains a joint anti-air model and this version has incorporated 21 new or updated threat models for enemy air-to-air and surface-to-air missiles. J-ACE can perform logic checks for maximum off-bore sight launch angle limits that are used by pilots developing tactics at both the U.S. Air Force's Fighter Weapon School and the U.S. Navy's Topgun programs. Additionally, J-ACE v5.0 contains updates on the weapon engagement zone (launch control) effectiveness data for seven U.S. systems and various architectural and graphical user interface improvements. Pilots use this JMEM to develop air superiority methods and by the U.S. Strategic Command for global strike mission planning.

In addition, JTCG/ME continued efforts to develop a JMEM in support of information operations. These efforts, performed in coordination with the U.S. Strategic Command, the U.S. Air Force Targeting Center, and various other government agencies, resulted in enhancements to computer network attack and electronic warfare tools. Initiatives related to JMEM development for other non-traditional effects (e.g., non-lethal weapons, high-energy laser, and high power microwave) continued in conjunction with the Joint Non-Lethal Weapons Directorate at Quantico, Virginia, and the High Energy Laser Joint Technology Office (HELJTO), Albuquerque, New Mexico.

JOINT AIRCRAFT SURVIVABILITY PROGRAM (JASP)

DOT&E sponsors and funds the JASP. The Naval Air Systems Command, the Army Aviation and Missile Command, and the Air Force Aeronautical Systems Center charter the program. DOT&E establishes objectives and priorities for JASP and exercises oversight of the program. JASP increases the effectiveness of DoD aircraft by developing techniques and technology to improve the survivability of U.S. military aircraft. Working with joint and Service staffs, other government agencies, and industry, JASP develops new capabilities and works to assure the Services jointly pursue it.

In FY11, JASP continued to work with the Office of the Assistant Secretary of Defense for Research and Engineering on the Helicopter Survivability Task Force (HSTF). This multi-disciplinary team is tasked with rapidly fielding techniques and technology to improve the survivability of helicopters in theater.

JASP expertise in survivability technologies supported funding two specific vulnerability reduction technologies by HSTF: Firetrace™ passive fire protection for the V-22 and multi-hit transparent armor for MH-47G and UH 60 helicopters. Firetrace™ installation on the V-22s deployed in Operation Enduring Freedom was completed in FY11. Plans to install Firetrace™ on all remaining V 22s were approved by the Navy in September 2011. The designs for multi-hit transparent armor are complete and will soon enter low-rate initial production to outfit aircraft in Afghanistan.

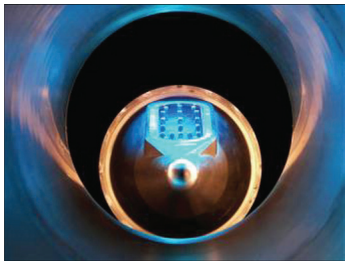
JASP supported the Joint Multi-Role (JMR) Technology Capabilities Demonstration (TCD) program as a member of the Platform Integrated Product Team. The JMR TCD purpose is to demonstrate transformational vertical lift capabilities for developing the next generation, vertical lift fleet. JASP was instrumental in establishing the assumptions and requirements for the vulnerability analysis to be used in evaluating the initial three government model prototypes.

JASP funded 56 multi-year survivability projects for $10.2 Million and delivered 40 reports in FY11. The following examples typify JASP efforts in four focus areas: susceptibility reduction, vulnerability reduction, survivability assessment, and combat damage assessment.

Susceptibility Reduction

These projects address urgent aircraft survivability needs emerging from Operations Enduring Freedom and New Dawn, as well as improve aircraft survivability against future threats.

Exploitation of a Missile Feature for Improved Countermeasure Effectiveness.



This project addresses the exploitation of a specific vulnerability common to most threat missiles. Studies with a signal injection hardware-in-the-loop model and seeker test van data confirmed the vulnerability. JASP is now working to confirm the initial results with other hardware-in-the-loop models and live fire test results. If confirmed, this technique may radically improve U.S. countermeasure effectiveness.

Advanced Techniques for Radio Frequency Countermeasures.

In partnership with the U.S. Army Communications-Electronics Research, Development, and Engineering Center, Intelligence and Information Warfare Directorate, this project is developing and testing countermeasures technology and techniques to increase aircraft survivability and situational

awareness for Army, Navy, and Air Force rotary-wing aircraft. Validated countermeasure techniques are being integrated into the Suite of Integrated Radio Frequency Countermeasures and receiver parameters are being incorporated into the APR-39 family of radar warning receivers by their respective program offices.

ShotSense 3D Aircraft Hostile Fire Indication System.

This project is fielding a high performance, low cost, size, weight, and power, un-cooled infrared threat detection system for the tracking and classification of small arms, rocket-propelled grenades (RPGs), missiles, and other hostile fire. In live fire tests, the system demonstrated the ability to detect and classify threats and cue radar for projectile tracking in natural and urban high clutter environments. The system was developed and is transitioning to counter-rocket, artillery, and mortar applications in the U.S. Army and the United Kingdom Ministry of Defense. A transition to the U.S. Special Operations Command Little Bird helicopter is being investigated.

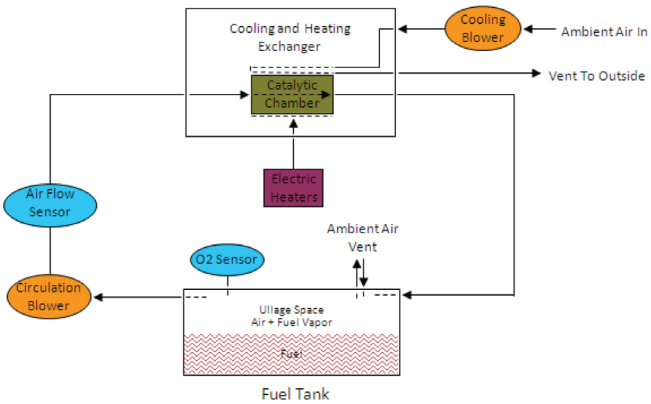
WeaponWatch® Hostile Fire Determination.

This project is expanding the WeaponWatch® hostile intent determination process to include algorithms for small arms, RPGs, and rockets. The updated algorithms will be implemented in the Ground Fire Acquisition System, by system developers, on AH-64D helicopters at Fort Campbell in the spring of 2012.

Vulnerability Reduction

Green On-Board Inert Gas Generating System.

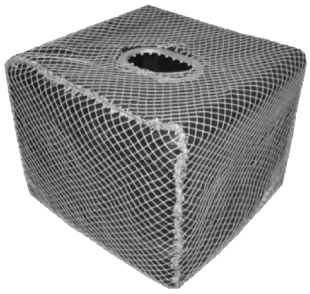
This project is developing a catalytic reactor system that converts the highly dangerous oxygen/fuel vapor mix, found in the empty space in a fuel tank, into carbon dioxide and water. The system, designed by a small company, Phyre Technology, is more environmentally friendly than currently fielded fuel tank inerting technologies, while being smaller, lighter, and having a lower projected life cycle cost. Initial laboratory testing demonstrated improved inerting performance under stressing flight profiles. System testing and optimization on a system sized for medium to large fixed-wing aircraft is underway.



Wireless Fire Detector.

This project is investigating a low-cost, lightweight, fast-acting, and reliable fire protection system that is easy to retrofit into fielded aircraft. The potential benefits are a rapid, light-weight system that can be installed without permanent modification to the aircraft, and a quicker, false-alarm-free detection/reporting system that could reduce the amount of extinguishing agent required and reduce pilot workload.

High Performance Fuel Bladder.



This project is developing a high performance fuel bladder using an exoskeleton design and new synthetic sealants resulting in lighter weight fuel containment with improved crash resistance. The exoskeleton absorbs and redistributes the impact loads to prevent failure and the new sealants are more effective in self-sealing when penetrated by a projectile. The AH-64 Apache Program Office supported the decision to build forward and aft fuel cells for testing in actual aircraft. The project is on schedule to complete qualification testing for the Apache fuel bladder by March 2012.

Survivability Assessment

JASP continues to develop aircraft survivability assessment methodologies ranging from the detailed system engineering level through the few-on-few campaign engagement level. These methodologies are used to support analyses of alternatives, LFT&E and OT&E, as well as aircraft system specification requirements and certification.

Improved Digital Radio Frequency Memory (DRFM) Jamming Representation in BRAWLER Aircraft.

This project is modifying the BRAWLER air-to-air engagement simulation model to update the jamming representation, making BRAWLER the first engagement-level simulation to include state of the art, DRFM jamming effects. This supports studies to improve counter-DRFM jamming tactics, techniques, and procedures and will support future studies to examine DRFM technology in towed and expendable decoys, the increase of pilot workload (due to the information DRFM jamming generates), and how to mitigate the effects.

Enhanced Prediction of Ball Round Penetration in Modeling and Simulation.

This project, performed in conjunction with the Joint Technical Coordinating Group for Munitions Effectiveness (JTCG/ME) and the developers of ProjPen, is improving performance of vulnerability analysis tools. ProjPen is the projectile penetration code used in most vulnerability analysis models and simulations. Testing was conducted by the Army to characterize ball round failure and penetration; the data will be incorporated into ProjPen by the Navy. Preliminary analyses show the old practice of using armor piercing rounds, as a surrogate for ball rounds, has led to

over-prediction of vulnerability and over-design of systems from a vulnerability point of view.

Combat Damage Assessment

JASP continued to support the Joint Combat Assessment Team (JCAT) in FY11. JCAT continues its operation in Afghanistan with full-time deployments in Regional Commands – South, Southwest, and East. JCAT supported Iraq and other areas of the world remotely or by rapid deployment from Afghanistan or the Continental U.S. 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 weapons, tactics, and logistics consultation to personnel and comprehensive briefings to commanders in charge of daily air operations. These efforts inform battlefield commanders, allowing them to adjust operational tactics, techniques, and procedures based on accurate threat assessments.

The JCAT trains the U.S. aviation community on potential aircraft threats and combat damage. JCAT Navy members hosted the 2011 Threat Weapons and Effects Seminar at Eglin AFB, Florida. Attendees included all four U.S. military Services, Department of State, Department of Homeland Security, Federal Aviation Administration, Department of Energy, Federal Bureau of Investigation, the Bureau of Alcohol, Tobacco, Firearms and Explosives, and U.S. industry partners. Additionally, JCAT provides information to many external customers, including capabilities briefs, intelligence updates, recent "shoot-down" briefs to discuss enemy tactics, techniques, and procedures, and combat damage collection and reporting.

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 for potential design changes, modified tactics, techniques, and procedures, or improved analysis tools. The need for these tests result from systems being exposed to new threats, used in new unanticipated tactics, or being operated in new combat environments, and the subsequent need for an assessment of their performance.

JLF supplements LFT&E of systems by testing new threats that the requirements community did not anticipate during the original development, or old threats employed in new ways. The RPG is an example of a threat employed differently than its intended design. 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's emphasis on Man-Portable Air-Defense Systems (MANPADS) threat characteristics and empirical vulnerability data continued in FY11. MANPADS have been a threat since the late 1960s but are seldom included in Test and Evaluation Master Plans or considered for LFT&E events. Immature modeling and test capability, test expense, and the perception of MANPADS as an overmatching threat, are the primary reasons given for limited test or analysis of this threat.

Over this same timeframe, the design of U.S. aircraft has evolved, significantly increasing ballistic survivability to the point that current platforms demonstrate some tolerance to MANPADS hits. This damage tolerance, along with the increasing proliferation of threat MANPADS, makes it critical to develop efficient test capabilities and a credible modeling capability to support future LFT&E strategies regarding MANPADS.

The following efforts are resolving key modeling and testing deficiencies highlighted in the JLF 2010 MANPADS Vulnerability Capabilities Roadmap.

MANPADS Threat Model Development – Fragment and Debris.

This project is collecting MANPADS fragment data of sufficient quality to improve the accuracy and credibility of MANPADS threat models used to assess and predict aircraft vulnerability. Static missile fragment data were collected in FY11 and dynamic missile fragment data testing is scheduled for early FY12.

Large Engine Vulnerability to MANPADS.

This project is determining the vulnerability of a large turbofan engine to a MANPADS threat. In partnership with the Department of Homeland Security and the National Aeronautics and Space Administration, Navy testers, with Air Force support, will shoot two MANPADS into operating CF6 50 engines to explore engine-nacelle fires, uncontained engine debris, and the ability to maintain controlled flight and safely land with damaged engines and airframes. Realistic test conditions include operational power settings, airflow, MANPADS impact velocity, detonation conditions, and shotline selection.

Supersonic Rocket on a Rope.

This project is evaluating the capability to "free-fly" a complete missile into a target with precision and repeatability. This project is applying a test technique

already used for U.S. missile systems testing. Essentially, the missile flies towards the target guided by "ropes" that are cut just feet before impact, allowing natural thrust and fuzing, yet controlling the guidance. Initial testing in FY11 demonstrated an impact accuracy of approximately 3 inches.

Rotorcraft Sponson RPG Vulnerability.

This project is demonstrating methods of suppressing fires resulting from RPG impacts to sponson fuel tanks - with emphasis on occupant survivability. For several U.S. rotorcraft, fuel tanks are contained in sponsons that are adjacent to the main cabin. Current data indicates that the U.S. aircraft are being shot with RPGs and sponsons should be protected.

Crew Compartment Fire Survivability.

This project is measuring the internal cabin environment during a fire to be able to consider the affect on crewmembers, and has the ability to extinguish fire with onboard hand-held equipment. This project developed a test fixture in FY11 to evaluate cabin fires and determine their byproducts (smoke, toxic fumes, heat) and impact on continued operation, escape, and survival.

Combat Incident Emerging Threat Investigation.

This project is addressing a recent combat incident in Afghanistan that 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 incident. JCAT requested JLF Air support by providing threat-target characterization data for their incident investigation. Results from two shots completed against a surrogate airframe were provided to JCAT. The initial results from these tests allowed JCAT to understand the engagement conditions and subsequent damage with confidence, increasing the value of information provided to operational commanders.

Ground Systems Programs

The goal of the Joint Live Fire Ground Systems Program (JLF Ground) is to fully characterize current threat weapons and munitions, providing critical empirical data to JTCG/ME and other interested agencies, such as Joint Improvised Explosive Defeat Organization. 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.

Exploitation of Generic Hull for Underbody Blast Injury Criterion Development.

This project is exploring the differences between the response of a surrogate and an actual human in the under-body blast (UBB) environment and evaluating the scientific basis for use of the Hybrid III automotive crash test dummy in UBB test and evaluation programs. This project will conduct a UBB experiment with a generic blast-resistant vehicle hull. This data will shape current research for creation of a validated UBB-specific human surrogate for use in LFT&E. The insights from this research will also directly aid the development of improved Soldier protection systems for the DoD.

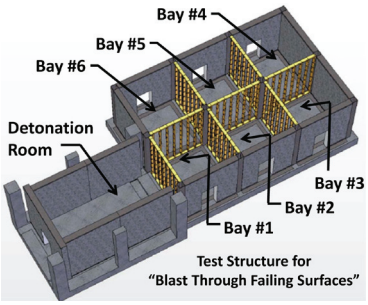
External Blast - Full Vehicle Blast Data and Validation.

This project will conduct testing to assess the vulnerability of the various armored, tracked threat vehicles to external air-blast loads. Additional generic plate testing will also be conducted. Engineers will use the data to develop lethal-miss-distance contours (the distance from a detonation that a person or equipment must be to survive) with respect to mobility, firepower, and catastrophic target kills.

Increase in JP-8 Flash Point Due to Heating Conditions.

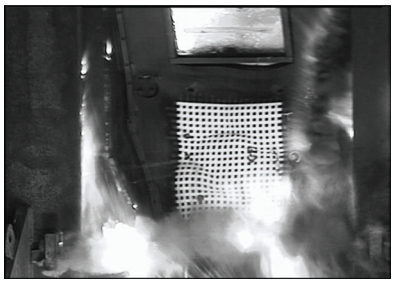
This project is investigating the relationship between the method for pre-heating and the resultant flash point of JP 8 fuel. Two heating methods, "open" and "closed," referring to whether the fuel is open to the atmosphere or not, were used to determine if the flash point of 50 gallons of JP 8 changed when heated continuously over a 48-hour period. These findings will be used to develop guidelines on suitable pre-test fuel preparation practices in relation to LFT&E.

Blast Through Failing Surfaces.



This project is conducting experiments to characterize air blast propagation through failing walls in a realistic two-dimensional array of urban rooms. Mission planning for military operations in urban terrain (MOUT) requires that weaponeers estimate the explosion-induced damage to urban structures, their contents, and their occupants. A key contributor to this damage is the air blast propagating through the light-duty walls, floors, ceilings, etc., comprising typical urban structures. Data from these experiments are being used by modelers to produce improved predictive methods for MOUT scenarios.

Composite Armor Deflection from IED Events.



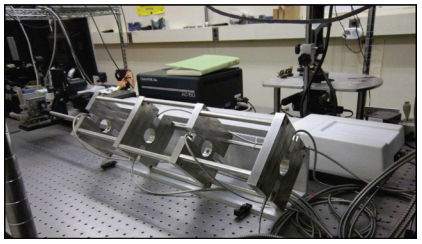
This project is exploring the possibility of dynamic composite armor deflection into vehicle crew compartments during IED events. Composite armors are lightweight solutions for vehicle systems and are designed to protect against an array of threats by absorbing fragment energy through material fracture and deformation. The objectives are to determine if the armor solutions withstood the IED threat and if deflections reached vehicle crew. If so, injury from blunt trauma would need to be assessed. The data will be used to determine Soldier vulnerability to armor deflection in the context of the differing armor recipes and door construction.

Exploratory Testing of Fragment Characterization System.

This project is part of a series of experiments to significantly improve warhead arena test data collection speed and confidence through automation of fragment characterization (3D coordinate location, mass, shape factor, etc.). Previous phases successfully demonstrated capability on a small scale using precision laboratory X-ray systems and had marginal success using high-power large cargo inspection X ray systems. This phase seeks to quantify the baseline capabilities of these systems and determine if modifications can produce a large-scale automated system at a practical cost point.

Instrumentation Accuracy Validation.

This project is demonstrating a ballistic reference chronograph to be used to develop measurement accuracy budgets and uncertainties as well as calibration factors for commonly used velocity instrumentation and techniques. The National Institute of Standards and Technology (NIST) developed the reference chronograph and performed the uncertainty analysis. The Army Research Laboratory (ARL) performed ballistic testing at Aberdeen Proving Ground, Maryland. NIST and ARL also investigated techniques and instrumentation to determine the accuracy of the pitch and yaw measurements. The results will allow the test community to determine if current projectile velocity techniques and instruments are within the uncertainty and error requirements.



Testing to Collect Data in Support of Projectile Penetration (ProjPen) Modeling Capability.

This project is conducting tests to gather data for small caliber armor piercing incendiary projectiles striking titanium plates. Testing is focused on penetration velocities and the gathering of residual masses and velocities of penetrating fragments. This will improve the quality of vulnerability and lethality analyses involving ProjPen. Both the Joint Technical Coordinating Group for Munitions Effectiveness (JTCG/ME) and JASP for the analysis of small caliber projectiles utilize ProjPen.

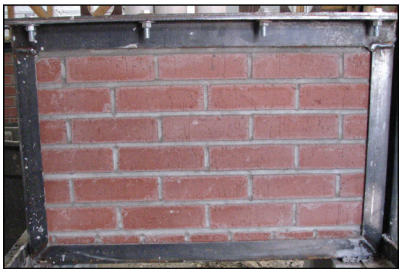
Fiberboard Recovery Media Improvement.

This project is conducting an evaluation to provide higher fidelity weapon effectiveness analysis by utilizing an improved fiberboard for fragment recovery media, typically implemented in warhead arena testing. Two of the greatest problems with using fiberboard are the flammability and variable density of the product. The ARL is investigating the feasibility of producing a product that has a more consistent density, and is less prone to loss due to fire, through discussions with various fiberboard manufacturers.

Testing to Collect Data in Support of Expanded Fast Air Target Encounter Penetration (FATEPEN) Modeling Capability.

This project is conducting tests to gather data to expand the capability of the engineering penetration and damage model FATEPEN as it applies to fragments striking brick targets. This testing is focused on debris collection for brick targets that are typical of general urban construction. The collected data will provide detailed information necessary to better model the interaction. JTCG/ME and others utilize FATEPEN for the effectiveness analysis of fragmenting warheads.

Military Operations in Urban Terrain (MOUT) Medium Caliber Wall Damage Characterization Tests.



This project is testing medium caliber (25 mm and 30 mm) threats used in MOUT environments against concrete and cinder block wall targets. The tests investigate penetration/perforation of kinetic energy and

high explosive munitions fired against conventional strength and ultra-high performance concrete walls, and behind-wall effects. Data obtained from the tests will allow improvement in lethality/vulnerability estimates of the munitions and validation of a cumulative damage computational tool that will model round-to-round damage to wall targets.

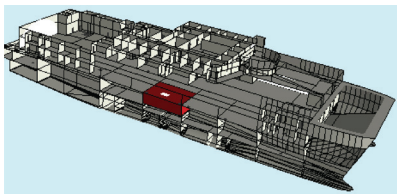
SEA SYSTEMS PROGRAM

The Joint Live Fire Sea Systems Program (JLF-Sea) made significant progress in FY11 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.

This project continues 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, modeling and simulation support, and analysis. The objective is to understand the behavior of aluminum, vice the more typical steel, hulls, and structures. In FY11, underwater, surface and air explosion testing was conducted, as well as an Office of Naval Research leveraged experiment to study methods that could be used to stop ships. This is a force protection concern, namely how could the Navy prevent a ship from entering a port, or proceeding toward a destination, while causing minimal damage to the ship and no injuries to the crew. These tests will help in understanding weapon effects against aluminum ships, and will complement the LFT&E programs for the Littoral Combat Ship and Joint High Speed Vessel.

Network Fire Model Enhancements.



This project is developing enhancements to the Fire and Smoke Simulator Model (FSSIM). Naval engineers use FSSIM to develop ship designs that limit the spread of fire and smoke. In FY11, the Navy added features to FSSIM addressing limitations for modeling aluminum structures, including surface melting and localized heating and spot melting, and incorporating fuel pool fires. These improvements will support designing more survivable ships.

Lithium Battery Vulnerability.

This project is characterizing the hazard that lithium and lithium-ion batteries can pose to a ship and its crew. NRL conducted tests to identify the type of reaction, burning characteristics, and heat release rate associated with exposing the batteries to dropping, heat, and fire. The results of the tests were then used to develop a Lithium Battery Casualty Mitigation System to minimize the risk to the ship and crew. This project, jointly funded by the Office of Naval Research, has developed a design based on the size and shape of an Mk 48 torpedo for use on submarines. During this fiscal year, a brass board prototype was built for risk reduction testing.

Diesel Submarine Underwater Explosion Testing.

This project continues the 2009 project agreement between the U.S. and German Navies to develop and validate 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 on the sea floor – a typically hard to detect position. Data on both the bottomed submarine response and shallow water loading will be obtained. This project effectively provides data to increase the fidelity of models and the accuracy of survivability assessments for a situation for which little data are currently available.

Glass Damage and Debris Caused by Shaped Charge Impact.

This project is gathering data on the debris produced by the impact of a shaped charge weapon on typical glass window panels used in a ship's Pilot House. The Navy tested RPGs, both statically detonating and actually firing at glass window samples, to characterize the debris field caused by shaped charge impact and penetration. Data from this testing will be used to improve damage predictions for this type of threat encounter.

Submarine Susceptibility to Mines.

This project is addressing the Navy's ability to assess the susceptibility and vulnerability of submarines to threat mines. 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 Modeling and Simulation tools that Services can use used to understand the effects of mine blasts on submarines.

LFT&E SPECIAL INTEREST PROGRAMS

Active Protection Systems (APS)

In response to FY08 legislation, DOT&E completed testing in August 2011 of seven foreign and domestic (two foreign, three domestic, and two combined foreign/domestic) active protection systems with the potential of protecting wheeled tactical vehicles. DOT&E will provide reports to Congress and acquisition leadership in 2QFY12. 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 personnel protection equipment testing. The Services and U.S. Special Operations Command are implementing the DoD testing protocol for hard body armor inserts published last year. The Defense Logistics Agency has incorporated the testing protocol into 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 future personal protective systems it desires to develop.

DOT&E, in partnership with the Services and the U.S. Special Operations Command, developed a new combat helmet testing protocol. It ensures the combat helmets provided to Service members meet ballistic protection requirements and provide uniform protection on the battlefield. The implementation of this protocol increases government oversight of personal protective equipment by requiring combat helmets (in addition to hard armor plates) to meet statistical measures of performance when tested in government facilities. DOT&E plans to work with the Services and the U.S. Special Operations Command to prepare a DoD-wide standard for testing of soft armor vests.

Joint Trauma Analysis and Prevention of Injury in Combat

In response to the DOT&E Mine Resistant Ambush Protected (MRAP) LFT&E Report of March 2010, former Secretary Gates tasked DOT&E to coordinate increasing the availability of data coming from the Joint Trauma Analysis and Prevention of Injury in Combat (JTAPIC) Program, as well as the Armed Forces Medical Examiner's Office. Presently, DOT&E has hosted four Senior Reviews with participants from the JTAPIC Program Office and all of the JTAPIC partners, including Army intelligence, medical and materiel analysts, Navy medical researchers, and Marine Corps intelligence analysts. Additionally, the Army Surgeon General initiated the execution of two working-level Lean Six Sigma (LSS) exercises with the goal of increasing the quality and volume of analytical outputs by improving internal operating processes. An improvement in these processes should increase the quality of the data shared between the partners, clarify the role of each partner as well as the JTAPIC Program Office, improve customer awareness of JTAPIC and its capabilities, and establish common procedures that should streamline data sharing and analytical processes between partners residing in various Commands and Services. Thus far, the four Senior Reviews hosted by DOT&E have focused on ensuring action items and taskings from the LSS exercises have been, or are in the process of being implemented. DOT&E expects that at future meetings the JTAPIC Program Office will report quantifiable metrics, as they become available, to demonstrate progress, as well as provide contextual demonstrations of how implementing LSS tasks has increased the efficiency of the partners' data sharing and analysis, as well as enhanced the Program Office's management of the partners and their products.

Warrior Injury Assessment Manikin (WIAMan)

Historically, large under-vehicle blast events have not been the predominant threat against which ground combat vehicles were required to protect. Therefore, test and evaluation techniques (including instrumentation and injury criteria) that address occupant injuries from these threats have remained immature. Current ground combat vehicle Live Fire testing is conducted using automotive crash test dummies and their associated injury criteria, all designed and developed for low-speed civilian car crashes. Medical data are required in order to improve the resolution of injury assessments during Live Fire testing of ground combat vehicles.

In August 2010, DOT&E sponsored an Army-led, 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 develop appropriate instrumentation to assess such injuries in testing. This program, known as the Warrior Injury Assessment Manikin (WIAMan), 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 anthropomorphic test device (ATD) 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. The second-generation prototype for this ATD is slated for completion in FY16, with full transition to the test and evaluation community in FY17. Development of a military-specific ATD for use in under-vehicle blast testing will better inform users, materiel developers, analysts, and evaluators about the levels of protection afforded by the vehicle to its occupants, and will ultimately lead to fielding more survivable vehicles. The resolution of current assessments is inadequate to inform users, vehicle designers, and evaluators, about the severity of injuries incurred in under-vehicle blast.