

## Live Fire Test and Evaluation Programs

### EXECUTIVE SUMMARY

U.S. Code Title 10, Section 2366, requires the Department to conduct realistic survivability testing of major conventional air, land, and sea platforms, and to conduct realistic lethality testing of major munition and missile systems. LFT&E is an integral part of DOT&E's evaluation of operational effectiveness, suitability, and survivability of defense acquisition programs. The LFT&E program goal is to provide an assessment of the survivability and/or lethality of a system in time to affect system design. The survivability assessment focus is on preventing or minimizing crew casualties. Additionally, DOT&E funds production of joint munitions effectiveness manuals; development of advanced technologies and methods to increase aircraft survivability; testing and evaluation of fielded air, land, and sea platforms; and projects that bring together the testing and training communities. LFT&E investment programs also support quick-reaction efforts aimed at addressing emerging warfighter needs.

LFT&E encompasses testing and evaluation throughout the acquisition cycle of a system. Testing for LFT&E begins at the component-level, typically during developmental testing, and culminates with system-level testing of a fully operational weapon or platform. Early identification of deficiencies through LFT&E allows time to affect trades and make changes before systems reach their final design. If it is impracticable and unreasonably expensive to conduct a test against a fully operational system, a waiver provision exists within the legislation allowing for an alternative approach for completing LFT&E. Strategies for completing LFT&E without full-up system-level testing rely more heavily on early component- and subassembly-level testing, and significantly leverage modeling and simulation.

Modeling and simulation development, verification, and validation rely on traceability to empirical data. Frequently, LFT&E investment programs generate the field data against which models and simulations are accredited. LFT&E follows a model-test-model approach. Pre-test predictions are developed before LFT&E events using the same models that analysts will use to complete system-level evaluations for scenarios not tested (due to schedule, cost, threat availability, and other limiting factors to realistic testing). Comparison of test results to model predictions identifies model deficiencies that when corrected, increase the model's fidelity and the confidence in accreditation.

Investment programs overseen by the LFT&E office enable DOT&E to respond to emerging warfighter needs.

#### **Joint Technical Coordinating Group for Munitions Effectiveness (JTTCG/ME)**

This group publishes weapon effectiveness manuals (Joint Munitions Effectiveness Manuals (JMEmS)) that guide the warfighter's weaponeering process. DOT&E oversight of the JTTCG/ME ensures that weapons effectiveness data are available to warfighters when weapons reach initial operational capability.

In FY05, the JTTCG/ME published a revised Collateral Damage Estimation (CDE) method based on tri-Service accredited JMEmS data. Central Command needed the revised method to allow rapid prosecution of high-interest targets without having to seek engagement approval outside of theater.

#### **Joint Aircraft Survivability Program (JASP)**

The JASP serves as the Department's focal point for aircraft survivability, establishing survivability as a design discipline, and furthering the advancement of aircraft survivability.

The Joint Combat Assessment Team (JCAT) of the JASP continued its deployment to Operation Iraqi Freedom (OIF) in direct support of the 3rd Marine Air Wing (MAW), and its replacement, the 2nd MAW. While in theater, JCAT also directly supported the Army's Aircraft Shoot-Down Assessment Team and the Combined Explosive Exploitation Cell.

#### **Joint Live Fire (JLF)**

OSD established the JLF program in March of 1984 as a formal process to test and evaluate fielded U.S. systems against realistic ballistic threats. Emphasis is on addressing emerging threats, needs of deployed forces, and assisting program managers in the acquisition community by testing legacy systems.

In FY05, JLF conducted a test program to characterize high-explosive fragmenting projectiles typical of Improvised Explosive Devices (IEDs) insurgents use in OIF. Characterization of threat weapons is a fundamental step in designing countermeasures to defeat them.

#### **Joint Test and Training Rapid Advanced Capabilities (JTTRAC)**

JTTRAC fosters the exchange of technology initiatives between the operational testing and user training communities. The program provides rapid enhancements to U.S. military testing and training capabilities to better support the warfighters' needs. In FY05, JTTRAC continued the Warrior Reach project, enhancing U.S. Special Operations Command's operational capability.

## ACTIVITY

In FY05, DOT&E oversaw the LFT&E survivability and/or lethality efforts of 96 acquisition programs. LFT&E published reports for the: CH-47F Improved Cargo Helicopter, Joint Standoff Weapon – Unitary, Guided Multiple Launch Rocket System, and V-22 Osprey. These LFT&E assessments are part of the individual program reports. DOT&E also supported quick-reaction efforts in FY05, and managed survivability and lethality technology investment programs.

## QUICK REACTION

**Joint Improvised Explosive Device Defeat Task Force**

DOT&E participated on the Joint Test Board (JTB) of the Joint IED Defeat Task Force. This group coordinates and synchronizes all IED test and evaluation events across the Services to maximize utility and reduce redundancy. The JTB maintains a classified web-based database of IED defeat systems that have been tested, are under test, and those to be tested. Capabilities and limitations assessments of those systems are also available. As a complementary effort, DOT&E funded test and assessment efforts to characterize the IED threat in emplacements representative of those encountered in current areas of operation. Characterization of threat weapons is a fundamental first step in designing countermeasures to defeat them.

**Tactical Vehicle Up-Armoring**

DOT&E continues to monitor and support the Army's up-armoring efforts. This critical program addresses urgent armoring needs of deployed forces and new acquisition programs through aggressive testing of potential tactical vehicle armor solutions. To help ensure suitability and effectiveness of up-armor packages prior to fielding, the Army conducts limited operational testing of the up-armored ground vehicles. However, test infrastructure limitations at Aberdeen Proving Ground (APG), Maryland, do not allow operational testing of the tactical vehicles as they are being employed in OIF. Specifically, APG lacks a high-speed vehicle test track to demonstrate the safety, compatibility, reliability, durability, and maintainability of up-armored vehicles when operated at high speeds consistent with current OIF tactics, techniques, and procedures. A proposed high-speed test track will compliment APG's current ground-vehicle armor research, development, test and evaluation mission, and infrastructure. Also, a high-speed test track will help ensure that suitable and effective armored ground vehicles are developed in the most effective, efficient manner possible. DOT&E strongly supports the Army's effort to acquire the proposed high-speed test track at APG.

**Small Caliber Rifle Cartridge Lethality**

DOT&E continued its involvement in an ongoing joint program to investigate the potential for a new small caliber rifle cartridge. In parallel with this effort, DOT&E is supporting a Joint Service Wound Ballistics Integrated Product Team to standardize small caliber lethality testing. Products from these efforts will be the identification of small caliber cartridges that exhibit greater

wounding ability and new Joint Service testing and assessment procedures for small caliber ammunition.

**Personal Body Armor**

DOT&E examined the root cause of inconsistencies in personal body armor effectiveness estimates. The result of that examination found that personal body armor test facilities use different qualification test procedures. DOT&E and the Army are cosponsoring a series of body armor tests to identify and select the best body armor qualification test procedure. This will conclude early in 2006. The result of this effort will be a revised standard test operating procedure for qualifying all production personal body armor prior to fielding.

**JTCG/ME**

The Joint Logistics Commanders chartered the JTCG/ME in 1968 to ensure development of consistent, credible effectiveness estimates for conventional munitions across the DoD. The primary application is weaponeering, the detailed technical planning of a weapon strike that occurs at multiple levels in the operational chain of command before actual combat application. To allow weaponeering, the JTCG/ME produces, distributes, and regularly updates JMEMS. JMEMS are classified CD-ROM products that provide the warfighter with personal computer software and data for rapid evaluation of alternative weapons. JMEMS assist the warfighter to effectively accomplish mission objectives, while minimizing collateral damage and maximizing mission success.

The JTCG/ME receives its priorities for the targets addressed by JMEMS from the annual Joint Staff (J-8) Munitions Requirements Process. This process ensures focus on the JMEMS that provide the highest priority data for current and future operations.

In FY05, the JTCG/ME published the first JMEM that begins the process of converting from a weapon-centric weaponeering tool to one that is target-centric. Moving to a target-centric JMEM responds to requests from the Joint Staff and mission planners within the Combatant Commands. In support of increasing combined and coalition operations, the JTCG/ME has begun integrating separate tools for air-to-surface, surface-to-surface, anti-air, and air defense applications into a single product. The first step was release of the JMEM Weaponeering System (JWS) v1.0 that combines the previous air-to-surface and surface-to-surface JMEMS. The JTCG/ME delivered this CD-ROM to over 900 separate users.

The JTCG/ME also released the Joint Anti-Air Combat Effectiveness: Air Superiority CD-ROM v3.1. This JMEM supports the community of fighter pilots concerned with the Air Superiority mission and provides estimates of air-to-air and threat surface-to-air weapons effectiveness. This release provided several new high-priority weapon target pairings to warfighters. In addition, the JTCG/ME generated effectiveness data to assist the Service schools in developing employment tactics for the AIM-9X weapon system.

An interim JWS release (v1.0.1) provided the operational community with an improved CDE method. The Military Targeting Committee (MTC) chartered the development of this method through a Tiger Team lead by the JTCG/ME. The Tiger Team used results from operations in both Iraq and Afghanistan, and documented the method in a Combined Joint Chiefs of Staff Memorandum, CJCSM 3160.01A. In a rapid-response effort, the JTCG/ME implemented the method in the form of certified JTCG/ME data tables. These tables, based upon JMEM tri-Service accredited data, provide Central Command collateral damage estimates for precision guided munitions, unguided munitions, surface-to-surface ballistic munitions, and cluster munitions for various scenarios. Their application allows Combatant Commands and military components to mitigate collateral damage to the point that they can attack sensitive targets without the need to elevate the decision for strike authority outside theater. The Tiger Team is now pursuing approval of the new method for use by all Combatant Commands and by the Joint Staff. It will then become a unified, common method employed by all Combatant Commanders and maintained by the JTCG/ME.

FY05 JTCG/ME efforts also included supporting tasks for upcoming JWS releases. JWS 1.1 will be a major update that the JTCG/ME will distribute in April 2006. The JTCG/ME will release JWS version 1.2, intended to provide new target data, in December 2006. JWS 1.1 will include:

- New and updated data for approximately 60 targets and 20 munitions or weapon systems (JWS 1.2 will provide data adequate to weaponize an additional 60 targets)
- A method to address tunnel targets and small masonry buildings
- An improved publishing method to provide users with better estimates
- A standard configuration-controlled interface to provide connectivity to real-time planning systems, such as:
  - Joint Targeting Toolbox
  - Joint Mission Planning System
  - Joint Advanced Deep Operations Coordination System
  - Air-Theater Battle Management Core Systems
  - Naval Fires Control System
  - Advanced Field Artillery Tactical Data System

In FY05, the JTCG/ME also initiated focused user training. This included development of training materials to support Service and joint weaponizing and mission planning schools, on-site training of instructors, and training of selected user groups. The result of this initiative is increased warfighter effectiveness through better use of JMEMs. In addition, this interaction provides the JTCG/ME with a refined understanding of user requirements to guide more effective updates of future JMEM releases.

## JASP

The Joint Aeronautical Commanders Group (JACG) established the JASP by Charter in January 2003, integrating the efforts

of four separate activities (the JTCG on Aircraft Survivability, the Joint Live Fire Aircraft Systems program, the Joint Combat Assessment Team, and the Joint Accreditation Support Activity). In 2005, the JACG realigned its mission to focus on logistics and re-chartered itself as the Joint Aeronautical Logistics Commanders (JALC). Recognizing the importance of the JASP mission, the Commanders of the Naval Air Systems Command, the Army's Aviation and Missile Command, and the Air Force's Air Systems Command, re-chartered the JASP separately from the JALC. The program focuses on establishing aircraft survivability as a design discipline and furthering aircraft survivability. This is done by developing vulnerability and susceptibility reduction technologies, providing standard accredited models to assess aircraft survivability, supporting combat survivability education, and collecting combat damage data for analysis.

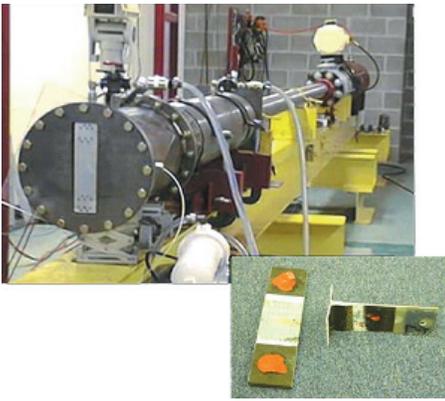
In FY05, JASP coordinated with the Defense acquisition community, the Department of Homeland Security, the Federal Aviation Administration, the Transportation Security Administration, and the National Aeronautics and Space Administration, to identify critical issues regarding aircraft survivability. JASP solicited project proposals focusing on those critical issues and subsequently funded approximately 50 survivability projects. Some of the more significant efforts include:

### Vulnerability Reduction

The Man-Portable Air-Defense System (MANPADS) Damage Effects Modeling project will provide a validated finite-element model of the SA-7 MANPADS threat. The model provides a physics-based method to predict synergistic MANPADS damage effects from kinetic energy and warhead detonations on aircraft systems. From this analysis, designers can better address the cascading damage typically suffered from a MANPADS engagement. This program directly supports the MANPADS vulnerability analysis needs of survivability and lethality model developers, tri-Service aircraft platform program managers, program offices, test managers, and industries responsible for aircraft development.

The Intumescent Instant Firewall project demonstrated the ability to contain a fire and minimize the amount of extinguishing agent required. Intumescent materials expand in the presence of heat. The relatively low-activation temperature of current intumescent materials caused premature initiation in the engine nacelle environment. JASP is funding research to develop an intumescent material with a higher activation temperature, which would be more suitable for aircraft vulnerability reduction applications. Intumescent materials may provide a lightweight, small-volume, passive-fire retardation method that is easily retrofitable to the current aircraft fleet.

The Joint Resistance to Ram project tested a variety of aircraft skin-spar joints to damage from an hydrodynamic ram. Aircraft manufacturers and other organizations provided a number of structural joint specimens, comprising a range of materials and configurations for test. The project provided data for the



evaluation of the dynamic failure properties of a wide variety of structural joint designs. The effort successfully demonstrated a cost-effective method for evaluating structural joint resistance to hydrodynamic ram loads, enabling future designs to be economically and effectively tested during development.

The lightweight experimental wing Hydrodynamic-Ram project provided data on the effects of hydrodynamic ram on lightweight composite wings. From this data, designers have developed mitigation techniques to reduce the ram effect in lightweight composite wings with integral fuel tanks. Aircraft designers are incorporating these techniques into production aircraft.



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## Survivability Assessment

Program managers for the Army's Future Cargo Aircraft and the Navy's Multi-Mission Maritime Aircraft programs are applying the Integrated Survivability Assessment (ISA) process that the JASP developed. The ISA offers program managers a better way to understand how the insertion of susceptibility and vulnerability reduction technologies affect the overall system survivability.

The JASP will complete development of an Imaging Infrared Sensor and Laser Effects model this year. This model will integrate knowledge of laser effects on optical and focal plane array-based sensors with existing models to provide a system-level simulation of advanced sensors. The ability to study countermeasure effectiveness and implementation feasibility in a system-level simulation is a critical step in considering laser-based countermeasures to defeat advanced electro-optical guided missiles. JASP is executing this project in cooperation with DOT&E's Center for Countermeasures.

The JASP will complete the first phase of verification and validation of an engineering, one-on-one engagement-level model that simulates the interaction between radio frequency emitter/weapon and a target. The model computes the target's probability of damage as a function of the radio frequency weapon's power density and range. JASP will verify the accuracy of the model and upgrade the model to run on current generation personal computers. The enhanced model will also allow lethality analysts to investigate the feasibility and effectiveness of selected directed-energy concepts against targets, such as aircraft, missiles, sensors, Command, Control, Communications,

Computers, and Intelligence (C4I), munitions, and improvised explosive devices.

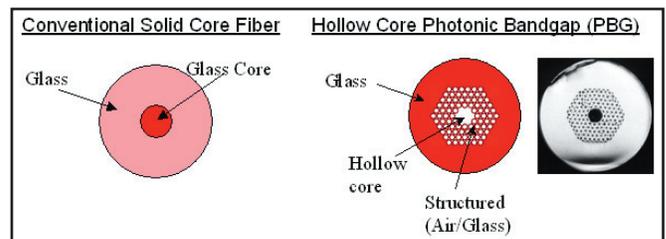
## Susceptibility Reduction

The Millimeter Wave (MMW) Electronic Warfare (EW) Receiver for Stand-in-Jammer project is developing a coherent channelized fast-tuning receiver for electronic attack. This project will be a critical part in future systems' ability to counter advanced MMW guided missiles and anti-aircraft artillery. Optimized to be low-cost and lightweight, this enabling technology is an important step in increasing electronic attack capabilities for small platforms, such as Unmanned Aerial Vehicles.

JASP is taking high-resolution Infrared Countermeasure (IRCM) measurements of several different flares. Analysts require these data to more accurately model off-board flares that they use in simulations to assess the effectiveness of IRCM. This project is being executed in coordination with DOT&E's Center for Countermeasures.

The Hostile Fire Indication test effort will investigate the effectiveness of existing ultra-violet warning systems to sense muzzle flashes and tracer bullets. If effective, these systems will enhance aircrew situational awareness, ultimately leading to increased aircraft survivability.

The Infrared Hollow Core Photonic Bandgap (HC-PBG) Fibers project will design and fabricate a glass fiber capable of distributing high-power, multi-spectral LASER energy for use in directed IRCM systems. This technology would allow for reduced weight and volume, and increased reliability for current and future Infrared Countermeasures systems. This project is a cooperative effort between JASP and DOT&E's Center for Countermeasures.



## JOINT COMBAT ASSESSMENT TEAM (JCAT)

The Joint Combat Assessment Team (JCAT) continued its deployment to OIF in direct support of the 3rd MAW, and its replacement, the 2nd MAW. While in theater, JCAT also directly supported the Army's Aircraft Shoot-Down Assessment Team and the Combined Explosive Exploitation Cell. These teams, embedded with operational forces, relay vital information on enemy tactics, techniques, and procedures to operational commanders so that they can adjust their operations to respond to the immediate threat. Additionally, these teams relay vital information back to organizations like the JASP and the Joint IED Defeat Task Force so that they can immediately begin working to develop solutions to mitigate the threat. JCAT accomplished this by inspecting damaged or destroyed aircraft, acquiring available maintenance documentation, and conducting interviews with

aircrew and intelligence personnel. JCAT consulted weapons, tactics, and logistics personnel, and provided comprehensive briefings to commanders in charge of daily air operations.

A second, but equally important mission, was the hands-on combat forensics training of the maintenance personnel in the field who directly work on the battle-damaged aircraft. This multiplied the JCAT's effectiveness because it allowed battle-damage assessments and data collection to continue when JCAT was elsewhere deployed.

The 2nd MAW used the data collected by JCAT on small arms damage to its Cobra helicopters to design a clear canopy protection system that provides the aircrew significant protection against the small arms threat with minimum weight and helicopter performance penalties.

## JLF

The Joint Live Fire (JLF) program consists of three groups: Aircraft Systems (JLF/AS), Armor/Anti-Armor (JLF/A/AA), and Sea Systems (JLF/SS). Following are examples of projects funded by JLF.

### Aircraft Systems Program

JLF/AS FY05 projects provided empirical data on currently fielded U.S. aircraft in order to obtain a better understanding of their vulnerability and identify ways to reduce that vulnerability. These efforts provided information to aid in combat mission planning, increased aircraft and aircrew combat survival and effectiveness, provided battle-damage assessment repair training, and provided design recommendations to reduce the ballistic vulnerability of current and future U.S. aircraft.

In response to a request from Operation Enduring Freedom/Operation Iraqi Freedom (OEF/OIF) helicopter pilots, JLF/AS initiated an effort to investigate a new threat to rotary-wing and cargo aircraft. Based upon evidence from OEF/OIF, insurgents are using unguided rockets to attack helicopters, an employment of these weapons not before seen. Therefore, an emerging requirement now exists for lethality, vulnerability, and threat characterization information on select foreign unguided rockets against U.S. rotary-wing and cargo aircraft. Using threat munitions identified through intelligence sources, testers are planning a series of ballistic tests to address this emerging warfighter need. Updated threat characterization, helicopter, and cargo aircraft vulnerability data will help the warfighter understand the threat environment in which they fly, and will help program managers mitigate this threat through engineering change proposals to their platforms.

### CH-47D Chinook

JLF/AS completed an effort in partnership with the cargo helicopter program manager and commercial armor developers. This effort



is to design, manufacture, and qualify a shield that will reduce the probability of fuel fires resulting from small caliber projectile impacts on the engine fuel feed shutoff valve. Three armor manufacturers provided samples, and JLF/AS completed 25 shots in September 2004. Due to the success of this effort, rotary-wing program offices now have a proven vulnerability reduction feature that they can adapt to their specific platforms.

**Apache Ammunition Magazine.** Combat data from OEF/OIF indicates the Apache ammunition magazine is prone to fail given a ballistic hit. This project will identify ways to improve component hardness and performance when hit, and will produce component vulnerability tables and other modeling and simulation data for vulnerability analysis. Also, this effort will determine if the current practice of using ammunition packs (like armor) to shield pilots from ballistic hits is safe. The Apache Block II survivability analysis and evaluation effort will also benefit from this information.

**Helicopter Ordnance Vulnerability.** JLF/AS initiated this effort to investigate helicopter ordnance reactions to various small arms, anti-aircraft artillery, and fragments reported as threats in OEF/OIF. Based upon evidence collected in OIF on an OH-58 Kiowa Warrior, survivability engineers analytically concluded that the helicopter-stowed rocket motor experienced a low-order burn, which is the expected reaction to a ballistic attack. Therefore, no additional testing or analysis is required and the JLF/AS will provide a detailed report on their analysis.

**OH-58D Kiowa Warrior.** JLF/AS completed planning for OH-58D testing to address damage suffered by the helicopter in OEF/OIF.

Tests planned include gunfire tests versus cockpit components, fuel system components, and main and tail rotor components, to obtain a basic understanding of the potential for subsystem degradation/disablement and system kills. This information will also be valuable to the Armed Reconnaissance Helicopter program.



**A-10 Warthog.** The A-10 wing and fuselage dry bay foam

was recently changed to increase affordability and maintainability. The fire retardant performance of the foam is untested under airflow conditions against combat-representative ballistic threats. In conjunction with the A-10 project office, JLF/AS will test the new dry bay foam in a combination of airflow and ballistic weapon testing. Results of these tests will verify



that the new foam does not reduce platform survivability, nor increases maintenance procedures.

**35 mm Airburst Munitions.** JLF/AS recently conducted tests using a new, widely available 35 mm airburst munition against representative Close Air Support (CAS) aircraft. The purpose of this project was to gather data to define the damaging effects of the 35 mm airburst munition's sub-projectiles against typical structural and system components of fixed and rotorcraft CAS aircraft.

**CH-53E Super Stallion.** JLF/AS entered the third year of a multi-year investigation into the vulnerability of the CH-53E platform. In FY04, JLF/AS conducted tests against CH-53E rotor and drive subsystems (main and tail rotor blades, tail drive shaft disconnect coupling) under representative dynamic loads. JLF/AS used these tests to gather



damage data and perform post damage-operating endurance testing on dynamic components to evaluate the reduction, or loss of, a dynamic flight-load capability. JLF/AS will conduct CH-53E fuel system testing in FY06. The CH-53E project is contributing to PMA-261 efforts to reduce the vulnerability of the fielded CH-53E, as well as identify areas to upgrade the Heavy Lift Replacement (HLR).

**UH-60 Black Hawk.** JLF/AS is conducting tests of UH-60 dry bay foam alternatives, improved durability gearbox run dry capability, and engine nacelle fire extinguishing system effectiveness. The results of these projects are applicable to all tri-Service H-60 aircraft and to future production variants, including the Army's UH-60M model and the Navy's MH-60R and MH-60S.

**Enhanced Powder Panel Validation.** The JASP began investing in powder panel development in the early 2000's with the goal of offering airframe manufacturers an advanced passive fire extinguishing technology. Enhanced powder panels offer significant



improvement in passive fire extinguishing, and provide a reliable and virtually maintenance-free means of fire mitigation for aircraft dry bays. Baseline testing of these panels demonstrated their ability to increase powder release, provide better powder

dispersion over longer dispersion periods, and afford greater design flexibility. JLF/AS is conducting testing to validate the effectiveness and air-worthiness of this technology. JASP can then offer this technology to program offices to retrofit current aircraft.

**Predator.** This two-phase effort provides system vulnerability testing of a Predator fuselage and subsystems replica (fuel, propulsion, and control) before and after select vulnerability reduction features are in place. Phase I (FY05) investigates component-level vulnerability of Predator hardware; Phase II (FY06) will include system-level vulnerability testing. JLF is supporting the UAV Program Office in identifying vulnerability reduction improvements to present and future blocks of the aircraft. Although unmanned, and thereby exempt from Title 10 LFT&E, the survivability of UAVs is increasingly critical to battlefield situation awareness and mission success.



**Rocket-Propelled Grenades (RPGs).** As seen in recent armed conflict, adversaries are using non-traditional weapons, such as anti-tank RPGs, against aircraft. The JLF/AS investigated the vulnerability of front-line rotorcraft to this threat by testing AH-1 Cobra aircraft. The goal of this effort was to understand the damage mechanisms of this threat, and to identify survivability enhancements to mitigate its effect. This effort paralleled the JLF/A/AA effort that characterized the RPG in a fragment arena environment. Results were used to update threat weapons effects and platform vulnerability databases for use in designing future aircraft.



**MANPADS.** JLF/AS initiated a multi-year effort to investigate the vulnerability of large turbofan engines to MANPADS. Test results from this effort will support large transport aircraft operational risk assessments and vulnerability analyses leading to improved warfighter protection. JLF/AS initiated a joint effort with the National Aeronautics and



Space Administration. This project will assess MANPADS' damage expectations on control surfaces, which will help identify the magnitude of the MANPADS' threat relative to large military and commercial aircraft. Data generated from this effort will allow validation of MANPADS aircraft damage models and will support development of layered counter-MANPADS protection concepts.

## Armor/Anti-Armor Program

JLF/A/AA FY05 projects focused on addressing emerging warfighter needs and providing empirical data for the JTCG/ME in support of their efforts to address Combatant Commander's weaponeering priorities. JLF/A/AA typically examines air-to-surface and surface-to-surface weapons, in addition to ground tactical vehicles and operations in urban environments.

## Military Operations in Urban Terrain (MOUT) Secondary Debris Characterization.



JLF/A/AA conducted tests of tank and artillery rounds fired against concrete walls to collect secondary debris data. This effort leverages ongoing MOUT efforts across the Services, and specifically benefits the Army's Standardized MOUT Testing and Target

Board, the Army's Engineering Research and Development Center, and the JTCG/ME's ongoing collateral damage estimation efforts. The Army Research Laboratory is also using the data collected to increase the fidelity of personnel vulnerability models such as the Operational Requirement-based Casualty Assessment (ORCA).

## Sensor-Fuzed Weapon Cold-Target Effectiveness.



JLF/A/AA funded testing of the Sensor-Fuzed Weapon's (SFW) ability to identify, target, and defeat solar-heated-only "cold targets." SFW is an air-delivered weapon designed to defeat heavy armor targets. The SFW was not designed

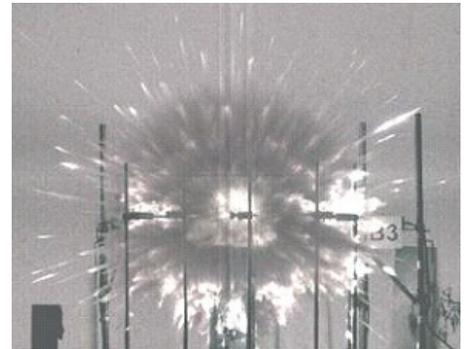
to be effective against a "cold" weapon, like a HAWK missile battery. However, these types of "cold" targets have become high-priority targets. The JTCG/ME will use the results of this test to update their JMEmS. The program included sensor test and evaluation, as well as vulnerability modeling. In the initial round of testing, infrared signature collection and analysis of various components of a HAWK missile battery demonstrated

sufficient solar heating to allow the sensor to recognize the target and issue a fire command.

**RPG Characterization Tests.** JLF/A/AA funded testing to collect arena and free-field blast characterization data that the JTCG/ME can use to build a threat model of a nominal RPG threat. With that model, analysts can complete high-fidelity vulnerability analyses of the RPG threat against a variety of U.S. platforms. This project provided new data for some RPG threats.

## IED Characterization for Blast and Fragmentation.

JLF/A/AA funded testing to establish fragmentation and blast characterization of projectiles used as IEDs. Testing included three arena tests to collect fragmentation and blast overpressure data. These tests captured ground surface effects in an IED configuration representative of the emplacement conditions observed in OIF. Analysts will use the test data in vulnerability/lethality modeling and simulation efforts to maximize survivability enhancements to current and future weapon platforms.



## Sea Systems Program

The JLF Sea program is Navy-centric, where the JLF/AS and JLF/A/AA programs have application across more than one Service. This is due to the uniqueness of personnel survivability and platform recoverability issues associated with surface ships and submarines. Where practical, lessons learned from JLF/SS efforts are shared across the Services.

## Damage Control Readiness Evaluation.

This project brings together the testing and training communities to develop metrics for evaluating damage control readiness, and to improve initial and refresher damage control training for shipboard crews. This project will provide the Fleet:



- A method for assessing damage control readiness
- Updated and improved initial and refresher damage control training modules
- Recommendations for future training enhancements

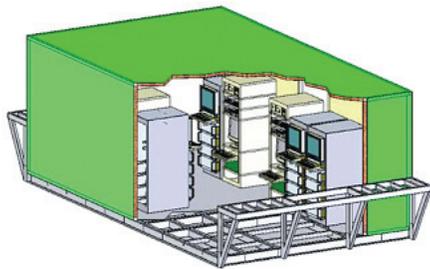
**Hydraulic Fluid Hazard Analysis.** This project examines the probability of a hydraulic fluid fire or explosion onboard surface ships and submarines. The Naval Research Laboratory



will research hydraulic fluid fires by reviewing results of shock test trials, examining casualty and maintenance reports, and conducting interviews with active duty and retired Navy personnel. A

vulnerability analysis will then consider possible ignition sources for hydraulic fires. The final analysis will provide engineers with an assessment of the probability of hydraulic fires and their relevant impact to overall vessel survivability.

**Shipboard Space Fire Testing.** The fire threat in shipboard spaces has not been adequately quantified. This project will



examine the potential for fire in enclosed shipboard spaces. This will be done by taking into consideration ignition sources and fire sustainability due to materials and equipment stowed

within those spaces. Products from this effort will improve the design of shipboard spaces and will provide empirical data for improvement, verification, and validation of fire models.

**Ship Response to Terrorist Attack.** JLF initiated a two-year project in cooperation with Germany to validate a simulation tool



for ship survivability to surface-borne threats. A U.S.-built destroyer recently decommissioned by the German Navy, will be the subject of a series of nine explosive tests. JLF will provide funding

to add an additional surface explosion test to the nine-shot matrix, effectively leveraging a joint U.S./German investment of nearly \$15 Million. Products from this effort will increase the fidelity of models, validate existing models and simulations, increase the accuracy of survivability assessments, and improve design capabilities to mitigate the effects of blast overpressure.

### **Survivability of Ships Built to Commercial Standards.**

Based on historical evidence, commercial hull structures have demonstrated a higher susceptibility to underwater shock damage than hull structures built to Navy standards. Although the Navy has conducted limited side-by-side comparison testing between a Navy-designed hull and a commercial hull as recently as 1998, little is known about the resistance of commercial hull structures

to underwater explosive loadings.

This project will use testing and models to assess the survivability of ships built to commercial standards, thereby improving the fidelity of future ship survivability assessments. This will directly benefit ongoing acquisition programs, such as the Joint High-Speed Vessel, the T-AKE, and the T-AOE(X).



**Submarine Susceptibility to Mines.** This project will improve the current capability to more accurately predict threat mine actuation ranges for various threats against submarines.

Through testing and susceptibility analysis, improvements will be made to survivability assessment methods. This will benefit future survivability assessments and will directly affect current vulnerability databases for vessels such as the SSGN and *Virginia* classes.



### **JTTRAC PROGRAM**

The FY97 Defense Appropriations Bill included congressional funding to investigate alternative uses of simulation and training technology in support of LFT&E. This initiative became the Live Fire Testing and Training (LFT&T) program. The program's name changed to the Joint Test and Training Rapid Advanced Capabilities (JTTRAC) Program in FY05, to reflect the program's emphasis on rapidly fielding solutions.

JTTRAC has funded 32 projects, totaling approximately \$34 Million, since its inception. Due to limited funding, JTTRAC funded only the Warrior Reach Project in FY05. No funding is available to continue the JTTRAC program after FY06.

- Warrior Reach is a joint initiative to enhance U.S. Special Operations Command's (SOCOM) operational capabilities at the tactical level to support Global War on Terrorism (GWOT). Warrior Reach addresses SOCOM GWOT requirements, and mission preparation and execution capability shortfalls identified during OEF/OIF, and other ongoing GWOT operations.
- Warrior Reach will:
  - Provide a deployable, tactical, secure network capability that ensures accurate and timely distribution of Blue Force Tracking data to command and control nodes (e.g., Joint Task Force Headquarters) and tactical elements (e.g., Combat Control Team) in test events, training events, or warfighter operations when national technical means are not available for support.
  - Facilitate and support OSD's Training Transformation Strategic and Implementation Plans and U.S. Joint Forces

# LFT&E PROGRAMS

Command's Joint National Training Capability initiative by providing a deployable, live-force tracking capability for the Joint Mission Preparation, Rehearsal, and Operational Network.

- Support Special Operations Forces/ Conventional Forces Concept of Operations and Tactics, Techniques, and Procedures development.
- Once fully developed, Warrior Reach will be available as an instrumentation tool for training exercises and operational test and evaluation.



