Proof Positive

Joint Live Fire Testing Assesses the Lethality And Protection Of Our Own Equipment And Foreign Materiel

by Thomas Julian and Robert Wojciechowski

A typical target, the BMP 2 is to be tested against the Javelin antitank missile. (Story photos supplied by U.S. Army Test Center, Aberdeen Proving Ground, Md.)

The Joint Live Fire (JLF) program was initiated by the Office of the Secretary of Defense (OSD) in March of 1984 because there was no formal process to test fielded U.S. systems against realistic threats.

The cold war was intense at the time. There was great interest in assuring effective capability, and a need to accurately determine the effectiveness of U.S. systems against the Soviet threat.

The U.S. had been successful in acquiring a significant stock of threat systems; we knew what they had, but we did not know how well their systems stood up against ours, and vice versa.

The Joint Live Fire program was chartered to focus, through live firing of real munitions, on the vulnerability of fielded armored vehicles and combat aircraft against actual threat systems, and the lethality of U.S. munitions against those threats.

OSD provides the program funding, buys the test articles, and provides technical oversight. The Joint Technical Coordinating Groups (JTCG) for Aircraft Survivability and Munitions Effectiveness administer the programs. The JTCGs, under guidance from OSD, directly coordinate test planning and program direction while the individual services execute and support the tests.

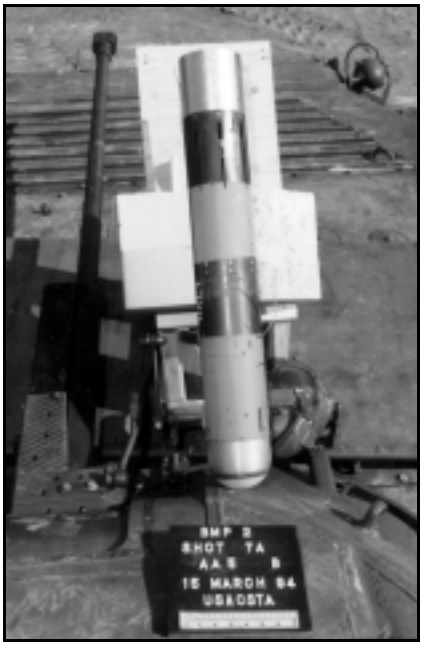
There are two distinct divisions of the JLF program, Aircraft Survivability and Armor/Anti-armor. The program has four primary objectives:

- Establish actual test data on the vulnerability of fielded U.S. systems to actual threat weapons, and the lethality of fielded U.S. munitions or missiles against threat targets.
- Provide insights into necessary U.S. system design changes, such as moving ammunition storage racks to provide greater protection to the crew members.
- Develop Battle Damage Assessment and Repair (BDAR) information to enhance equipment repair in the field for restoration into the battle.
- Provide insights into lethality and vulnerability modeling and simulations that are used in live-fire testing of new systems. The information also helps train soldiers, for example, by enhancing crew training to better report the results of firing engagements at threat systems.

Initially, JLF was a program covering a selected set of front-line U.S. systems. However, there are numerous systems which might be involved in combat beyond those selected or initially imagined, plus the potential new threats that are always evolving, so the program has continued to meet a never-ending need. Initially, the Navy was not involved in the JLF program, but the program has been expanded to include testing of surface ships.

There have been tests of numerous aircraft and armored systems since the program started. Much of the Army's current helicopter fleet (AH-64, UH-60, AH-1S), many Air Force and Navy front-line aircraft (F-15, F-16, F-18, A-6, AV-8A/B) and several Soviet attack helicopters and fighters (MI-24, MIG-21, MIG-23) have been tested. Additionally, most of the Army and Marine Corps armored combat vehicles (M1/M1A1, M60, M48, M2/M3, M113, AAVP-7, LAV-25) and several Soviet armored systems (T-62, T-72, BMP, BRDM) have been tested to determine the vulnerability of U.S. systems to threat systems, or the lethality of U.S. weapons and ammunition (M829, M919, M791, TOW, Hellfire, etc.) against threat systems.

While the JLF program conceptually may have spawned interest resulting in the Congressionally mandated Live Fire Test (LFT) program, each has its own area of applicability. The LFT program focuses on new systems in development, or systems that have product changes or improvements that involve vulnerability or lethality. The driving interest in LFT is to include live-fire testing early in the system acquisition processes, complete the testing, and identify appropriate design changes prior to a decision to proceed beyond low rate initial production. The JLF program focuses on fielded systems which have raised questions involving



Javelin missile is placed at preplanned impact point prior to test.

The BMP at moment of Javelin warhead ignition. Note armor plate shields around test area to ensure safety.

live fire exposure, or where threat weapon systems change.

JLF often discovers small changes that have large impacts on survivability. These items have developed as a result of JLF, for example:

- Jam-resistant actuators for aircraft which are both lighter and more survivable
- Shielding of critical components of a system
- Adding extra wire to improve redundancy
- Moving detectors to improve warnings
- Modifying software to enhance operations
- Revising stowage to save lives
- Shock mounting soft components to provide durability
- Changing fasteners to create better access
- Fuel management changes to improve efficiency
- Changing trigger pull thresholds so soldiers can better use their equipment.

These and many other beneficial improvements have been the large payoffs from small changes brought about from the JLF program.

The program offers many benefits not available from other sources. As mentioned above, funding for the program is provided from the OSD budget, and administered by the Joint Technical Coordinating Groups. OSD also provides the target materials, if the encounter is a U.S. system lethality investigation. In practice, the service involved provides test support from its own resources as well. The service may also provide the U.S. system employed in the test, its ammunition, its operating crew, and the range facilities and range support.

As new systems arrive on the battlefield, threats change. Fielded systems are developed, based on the threat envisioned during early development of the system, and no matter how accurate the attempt at threat definition, the actual threat is always going to be different from that envisioned. Political alignments also change as the world situation evolves, as evidenced by the multiplicity of new U.S. interests since the breakup of the Soviet Union. The end of the cold war has brought new realignments, and potential involvements for U.S. forces not previously anticipated, either as combatants or in a peacekeeping role.

Coupled with the changing political scene, the reality is that weapon systems placed in the hands of troops now will be in use for several decades. The current U.S. Army truck fleet is running an average life of about 30 years, and counting. The UH-1 helicopter continues to be a robust system. While technology makes great strides, the service life of our deployed systems will continue to be extended.

Even though the system must undergo its mandated live fire testing before it can be produced in quantity for issue, it is likely that the threat facing the system during its operational life will be different from that it was designed for, or the need for improvements may become obvious under actual employment conditions. Questions of survivability and lethality always arise, which need to be answered by joint live-fire testing.

JLF also tests foreign vehicles or munitions, to determine the effectiveness of non-U.S. munitions and systems and to discover the pros and cons of a system's attributes that make it survivable. An example of this concept might be the M1 tank series, which has completed its live fire test, but, if a new threat develops, JLF will test that threat against the M1.

In a test in Nevada in 1995, a focus was on battlefield damage assessment of threat armored vehicles fired on by U.S. tank guns. The test determined what crews could expect to infer from through-the-sight observation of an impact. Aggregated Desert Storm data, from both Army and Air Force sources, based on BDA supplied by U.S. system operators, scored more than twice the number of Iraqi tanks killed than were present in the theater. This was a clear overestimation of the kills that actually occurred. In last year's JLF test, two

Mannequin representing BMP crewman after test.

different tanks, a T-62 and a T-72, plus a BMP armored personnel carrier, were fired on, using actual combat munitions and gunners. The targets were observed through the gunner's sight of the firing vehicle and through the sight of a companion vehicle during the firing. Even when it was clear the target was hit, it was not possible to determine whether a target perforation (hard kill) had occurred. Data was collected, however, to suggest state-of-the-art signature processing technologies could be employed to provide the crew a positive indication of perforation (hard kill) vs. nonperforation (damaged, but not a kill) in real time. If a kill determination was dependent upon the occurrence of a perforation, the JLF test confirmed that other sensing techniques would be needed. In addition to the daylight sights, use of thermal sights were also evaluated and, although what was seen was different from the daylight sights, the perforation conclusion still held. It was also determined, by placing an earth berm in front of the target, that a hit on the berm looks very similar to a hit on the tank when viewed through the sights, and a hit determination is likely to result, even when there actually is none. These JLF test results are a very useful source of data in BDA sensing, considerations for future developments of fire control systems and simulators, and training for tank crews.

Another potential benefit from the JLF program is the opportunity for live fire test exposure of systems categorized at levels less than major systems. LFT is mandated for those systems which are considered major systems based on the individual unit cost, or the aggregated cost of the production run (as in the case of munitions). In addition to these, there are many systems which have potential exposure to combat conditions, but which are not required to conduct full-up, full-scale live fire testing by the LFT criteria. Ground systems, like trucks used to move personnel and supplies, have a potential exposure to combat conditions, even when their primary use is not to perform a combat mission. This is especially important in the case of employment of U.S. forces in operations other than war. A recent example is the generation of casualties from vehicle exposure to mines in Bosnia. Truck design changes and/or modifications can be tested by exposure to potential threat mines, and the JLF program can serve as a helpful means for the production of data to assist in the design of these modifications.

Another potential use of the JLF program is in obtaining data on the use of so-called "gray" systems — U.S. or foreign manufactured systems either obtained through foreign military sales, or other sources, and employed against U.S. forces. The political changes mentioned above, and others like them, could conceivably result in changed loyalties leading to such a result. Thus the traditional engagement concept of "Blue-on-Red" may well be supplemented with "Blue-on-Gray," or even "Blue-on-Blue." There is, therefore, a need for data with which to plan employment of U.S. systems against such targets, and to consider the possible need for protection from them. This is potentially in the JLF program scope, and should be considered a possibility.

Another important aspect of JLF is to determine the limits of munitions lethality and vehicle vulnerability regardless of the "design requirements." Some of the most interesting results have been related to system performance outside the design envelope. For example, tests demonstrated that hits by overmatching munitions on the Bradley by no means guaranteed a "kill." Further, the crew and system would have survived many direct hits on stowed ammunition.

JLF has led to many changes that have directly affected the safety of U.S. crews, the fightability of systems, tactics for utilization in battle, and the designs of future systems. The JLF program continues to be highly relevant to the determination of system vulnerability and confirmation of system lethality.

If you have questions about the lethality or vulnerability of fielded systems that can be answered by data from live fire tests, the Joint Live Fire test program may offer answers. The OSD office overseeing the program is happy to discuss previous test data and considerations for future testing. The office is eager to assist the armed services and the defense industry in assuring the most capable defense for this country. For additional information, contact:

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