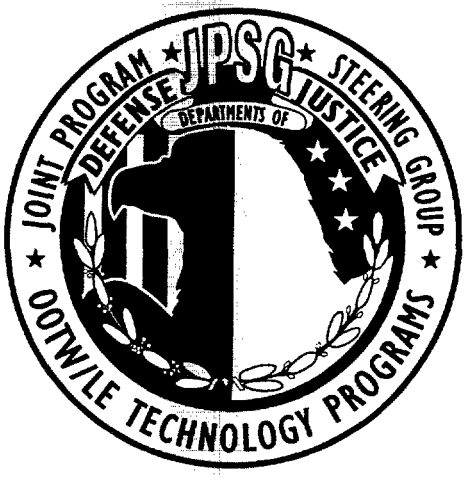
The
Limited Effects Technology (LET)
Program



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Background

The Limited Effects Technology (LET) Program is a joint technology development effort between the Departments of Defense and Justice. It is managed by the Joint (Defense-Justice) Program Steering Group (JPSG), which is established at the Defense Advanced Research Projects Agency (DARPA).

The LET Program was implemented under the auspices of a Memorandum of Understanding (MoU) between the Departments of Defense and Justice, for the sharing and joint development of technologies of use in both military operations other than war (OOTW) and law enforcement (LE) operations, which was executed on April 20, 1994. The MoU resulted from the realization that the technology needs of military forces engaged in OOTW—e.g., the provision of humanitarian assistance, peacekeeping, countering the flow of drugs into the United States, countering terrorism, etc.—and law enforcement forces engaged in LE operations were converging. There are three facets to this convergence: (1) a need to limit force, (2) common threats, and (3) common missions.

The Need to Limit Force. Increasingly, the military finds itself conducting operations such as peacekeeping, in which it is confronted by the mandate to apply only the minimum amount of force necessary to accomplish a particular mission. These are essentially the same rules under which LE agencies operate. As with their LE counterparts, military commanders find that these constraints can limit their options, and thus, may limit their effectiveness. On occasion, the severity of these constraints may leave them with the alternative of doing nothing or placing the lives of the personnel involved at risk.

Common Threats. Military technology is finding its way into criminal hands. Law officers are confronting a threat that looks more and more military. For example, narcotics' traffickers and smugglers use "bullet proof vests," electro-optic devices that enable them to see at night, and semi-automatic and even automatic weapons. The United States is also no longer immune from international terrorism, if it ever was, and law enforcement agencies must be able to deal with that threat.

Common Missions. Perhaps the best known examples of military and law enforcement participation in common missions are the "wars" being waged against narcotics and terrorism.

The potential benefits of a joint development program being clear, Congress, and senior officials in both Departments moved DARPA and the National Institute of Justice (NIJ) toward an agreement on such a program beginning in 1993. That agreement was formalized in the MoU. The MOU calls for an extendible five-year program. It established the JPSG to manage daily operations and an inter-agency Senior Review Group (SRG) to manage policy.

The JPSG is jointly staffed by DoD and DOJ representatives. Members have been drawn from DARPA, NIJ, the FBI, the Bureau of Prisons, and the US Army. It can work at any point along the Research, Development and Acquisition (RDA) spectrum. It can, for example, both support demonstrations of existing technology and development of new technologies.

The JPSG followed a three step approach in developing its technology programs, including the LET Program. (1) It examined the technology priorities of both communities. It then (2) identified those overlapping priorities that were not being pursued, and (3) developed efforts to address those priorities—in as much as funding would allow. The SRG approved the plan submitted to it by the JPSG in March 1995.

Program Thrusts

The JPSG Program focuses on seven main technology areas.

Concealed Weapons Detection. Concealed weapons pose a major threat to military and LE personnel. Existing detection systems, mainly metal detectors, have limited range, a high false alarm rate and are obtrusive, lending themselves to circumvention. Low metal content handguns and non-metallic stabbing and cutting weapons make detection particularly challenging. The JPSG seeks to develop safe, affordable and, in as much as possible, unobtrusive systems that can detect weapons, including those with little or no metal content, over 9 m away. Initial efforts focus on, but are not limited to, stationary devices. Four approaches are being pursued: (1) an x-ray sensor, (2) integration of passive millimeter wave (MMW) and infrared (IR) sensors, (3) integration of ultrasound and radar sensors, and (4) a low-frequency magnetic sensor. The x-ray sensor is now being demonstrated in a correctional institution in California.

Geo-Location/Navigation/Communications. Locating, identifying and monitoring the movement of individuals, vehicles and containers are important to LE and to the military. With better technologies, emergency medical care might be delivered faster, contraband and individuals tracked more accurately, stolen property more precisely located, etc. The JPSG seeks to develop and demonstrate such technologies. It relies heavily on ongoing DARPA efforts; specifically, in electronics miniaturization and packaging, especially of navigation technologies such as GPS, and reduction of power consumption. The JPSG has two efforts in this area: *Soldier 911* and Tagging. *Soldier 911* provides the capability to locate, identify and track the movement of individuals and vehicles, by using a device that can be handheld, attached to the harness system that a soldier uses to carry equipment, or mounted in a vehicle or aircraft. It can be programmed to provide early warning of approach to a dangerous area, and has the ability to emit a distress, or "911," call. The second project is an effort to develop and demonstrate a robust family of miniature, low cost, wireless, modular devices, to locate, identify, and monitor the movement of selected individuals and other mobile objects. *Soldier 911* is being demonstrated with selected U.S. forces.

Sniper Detection. Snipers are extremely dangerous. The main means of gunfire detection today, i.e., the human ear and eye, are inaccurate. The JPSG intends to develop and demonstrate affordable sniper detection systems that can detect and locate a sniper, to within a 3 m x 3 m box, in urban, as well as rural environments, to ranges over 1 km. Urban environments are challenging with respect to sniper detection because manmade structures cause echoes that complicate detection by acoustic means, and hide visual cues, i.e., muzzle flashes. This effort is developing systems that can be: (1) carried by and put in place by hand, (2) worn, and (3) mounted on vehicles. Technologies being explored employ acoustic, IR, integrated IR-acoustic, and integrated IR-laser sensors. Phase I acoustic testing was completed at Camp Pendelton, CA. Six prototypes of the best performing system are being delivered to the U.S. Army for training.

Information Technology. Both the LE and military communities respond to crises. How well they respond is often limited by the inability of the participants to communicate and share information readily and securely. The JPSG is addressing this problem by taking advantage of advances in civilian and government sponsored information and communications technologies. It will demonstrate an interagency crisis management system that provides the capability to communicate readily and securely and to share information among agencies. That will be achieved through innovative exploitation of the commercial communications infrastructure and communications security technology.

Personnel Armor. The bulk of the body armor and helmets issued to soldiers are designed to defeat shell fragments. Bullets, from both rifles and handguns, pose a serious threat in OOTW and LE operations. The majority of the body armor worn by LE personnel are designed to stop handgun bullets. Rifle bullets pose an increasingly serious threat to them. The JPSG seeks to provide body armor and helmets that provide bullet protection, at the minimum possible weight, through application of new materials and designs. Its efforts include: (1) development of lighter weight alternatives for the current Ranger Body Armor ballistic inserts; (2) a body armor that is highly wearable and inconspicuous and which provides some rifle protection; and (3) an improved helmet providing protection against all pistol and some rifle threats.

Biomedical Technology. The JPSG is sponsoring a limited demonstration of the application of telemedicine to provide medical services to remote locations. The demonstration will be conducted in Federal Penitentiaries. While telemedicine technology is fairly mature, its deployment and utilization is still low. Additionally, its benefits have not really been well quantified. This effort both seeks to expand the envelop with respect to telemedicine technology and to quantify its benefits. Prisons are responsible for providing full-time medical care to prisoners. In many places it is difficult to find specialists, or those willing to treat prisoners inside prisons. Telemedicine affords an excellent opportunity to extend the range of health care provided inside prisons and jails while avoiding costly, and potentially, dangerous trips to local hospitals. The military requires the same type of remote area medical information umbilical cord, both in war, and OOTW in such operations as providing humanitarian relief in Rwanda, disaster assistance to the victims of Hurricane Andrew, or the temporary detention of large groups of refugees. This capability is needed to provide medical care to deployed personnel and, as the mission dictates, the local populace, detainees, etc.

The final set of technologies that are being pursued are what are termed **Limited Effects Technologies, or LET**.

The Limited Effects Technology (LET) Program

Today rules of engagement, legal constraints, and policy—driven by considerations of the potential for injury to bystanders and unintended damage to property—may restrict the use of force by the military and LE. Both need better options for handling and containing riotous or violent crowds and for stopping fleeing suspects. The JPSG is sponsoring a number of efforts to provide less lethal, more effective ways to accomplish these tasks. A key consideration in each of these efforts is that the technology be legally and socially acceptable.

To stop individuals, the JPSG is sponsoring development of a ballistic, wireless, electric stun projectile. The JPSG is also sponsoring development of eyesafe laser devices to deter and to disorient individuals.

There is also a need for less lethal, faster acting, pyrotechnic devices, e.g., flash-bang grenades, smoke grenades, etc. The JPSG is funding a program to develop such devices.

Both military and LE representatives advising the JPSG agreed that crowd control using sound showed promise, but that the precise effects of such a technology were not well documented. As a result, the JPSG is sponsoring a study to determine these effects.

ELECTRIC STUN PROJECTILE

JAYCOR (San Diego, CA) is developing an electric stun projectile under JPSG sponsorship. This device is intended to provide the capability to intercept and stun an individual attacking an LE officer or soldier.

The JAYCOR device is a wireless, gas or conventionally propelled projectile with an integral power source. The prototype device has a diameter of 38 mm and a length of 130 mm. It can readily be made compatible with 37/40 mm launchers, such as the military's M203 grenade launcher. It weighs 150 grams. When it strikes an individual, it adheres to them and imparts an electric shock of sufficient magnitude to knock them down. Both adhesives and mechanical methods are being explored as means of adhesion. The projectile imparts shocks for a preset time interval using an internal timer. Additional shocks may be imparted using a radio remote control device that is under development. The prototype projectile's output is characterized by a pulse current of 4.9 amps, an effective pulse width of 1.6 μs, and a pulse repetition rate of 5.3 Hz. Phase II design goals are 8 amps, 3 μs, and 10 Hz. This should yield enhanced incapacitation. These characteristics are still well within the parameters of the electric stun devices found on the market.

This projectile provides a less lethal alternative to firearms. It is anticipated to be more effective than kinetic energy stun devices, such as "bean bags," in terms of incapacitation and should impart lesser or comparable levels of blunt trauma. In testing, the prototype device imparted roughly 70% of the impact force to a target that the KO1 (hard rubber) kinetic energy stun projectile imparts. On the other hand, it has a greater range than other types of electric stun devices, and so increases the margin of safety of its users.

Cost is a key factor in projectile design. In as much as possible off-the-shelf parts are used. Excluding non recurring costs, a prototype device costs between $50 and $100 to manufacture. The goal is to have a device that in production will cost between $15 and $25. This is comparable to the cost of the KO1.

A successful breadboard demonstration of the prototype device was conducted on August 1, 1996. Members of the 1st Marine Expeditionary Force participated. Fifty projectiles were fired from both bench top and handheld launchers at a target slightly over 9 m away. The projectiles employed used either barbs or adhesives as attachment mechanisms. Forty-six hit the target. The four that missed were fired from handheld launchers. The misses are attributable to aiming error on the part of the shooter. Nine of the forty-six projectiles were functional. All nine struck the target. Eight functioned properly, adhering to the target and imparting an electric shock. The one malfunction was

due to a failure to adhere to the target. This was attributable to a technician improperly applying adhesive to the projectile.

This effort should be completed in August 1997, with user evaluation. Two kinds of prototype devices are contemplated: a projectile that is compatible with the M203 grenade launcher for military application, and a launcher for LE application that may be covert. It may, for example, look like a riot baton or a flashlight.

Figure 1 shows the prototype JAYCOR stun projectile and the KO1 projectile. The JAYCOR projectile is on the left.

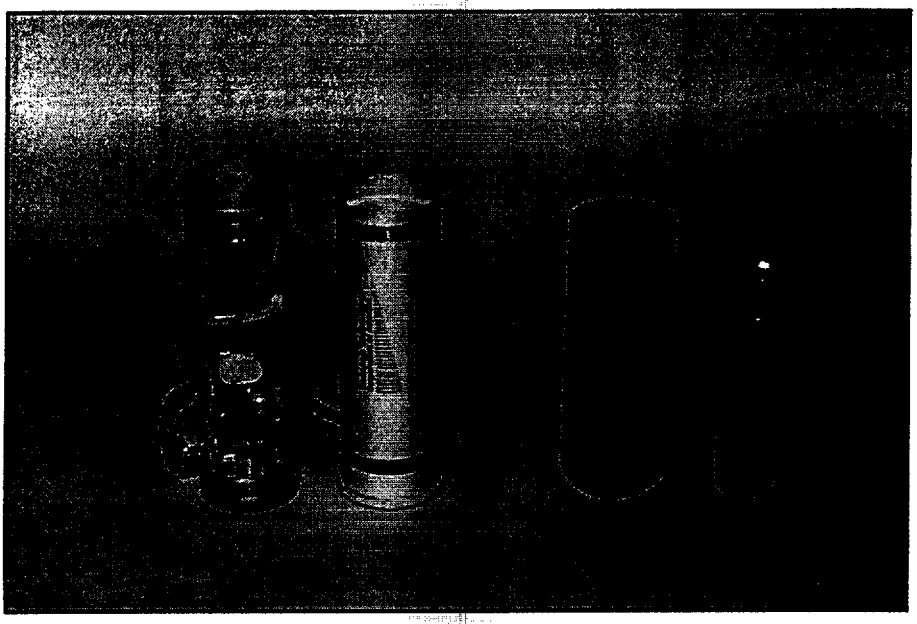

Figure 1. Electric and KE Stun Projectiles

LASER SURVEILLANCE AND DAZZLER SYSTEM

The Battlefield Observation and Surveillance System (BOSS) was developed for the JPSG by the U.S. Air Force's Phillips Laboratory. BOSS is a vehicular mounted laser surveillance and dazzler system. It is intended to be used to detect and to deter individuals, such as violent agitators in crowds or snipers and is eyesafe in its intended mode of operation.

BOSS is mounted on the 3/4 ton High Mobility Multipurpose Wheeled Vehicle (HMMWV). It integrates: (1) a thermal sensor (8 - 12 μm FLIR), that cues it to a possible target; (2) a 15 watt, 808 nm (near IR), air cooled laser that provides illumination for a low light level TV, to acquire that target; and (3) a 1 watt, 532 nm (green) laser that illuminates the target. This illumination provides both a psychological effect—the individual knows they are being "targeted," and a physiological effect—it dazzles the individual. Potentially, it could also be used for target designation for other weapons systems. BOSS's operational range at night is from 30 - 1000 m (+). While BOSS is still capable of acquiring individuals to a range of roughly 1000 m during the day, the green laser is only effective in illuminating them to about a range of 420 m. The sensors and laser lens assemblies are mounted in gimbaled turrets, that provide BOSS a degree of ability to acquire and illuminate targets while moving. The lasers, which are located in the HMMWV, are

coupled to lens assemblies in the turrets through fiber optic cables. BOSS was successfully demonstrated in June 1996 at Phillips Laboratory in Albuquerque, NM.

BOSS offers the potential capability to detect snipers before they fire, through reflection of the laser light from their weapons' optics. The integration of BOSS with acoustic sniper detection systems developed under the JPSG's auspices is being explored.

Figure 2 shows scenes from the BOSS demonstration in June. At the top left is a picture of the green laser shooting at moonrise. The picture at the bottom left is of an individual being designated by the green laser at ~ 850 m. The picture at the right is an over exposure of the BOSS system being set-up.

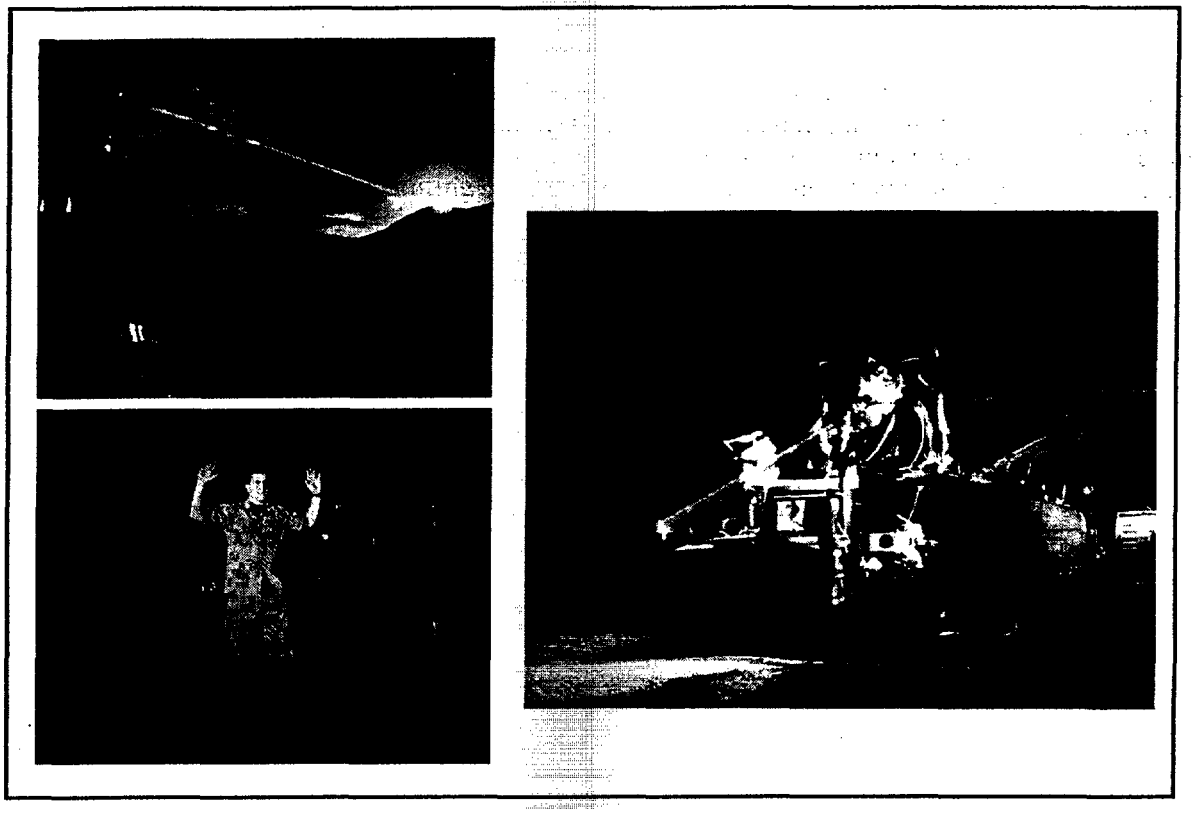

Figure 2. BOSS System Demonstration

HANDHELD LASER DAZZLER

A hand-held, laser dazzler, intended to temporarily disorient individuals, or small groups of individuals, is being developed for the JPSG by LE Systems of Glastonbury, CT. LE Systems is actually exploring development of two types of devices. The first will be a small back pack laser coupled through a fiber optic cable to a helmet mounted lens assembly, providing for "hands off" operation. The second type of device may possibly be configured to resemble a police flash light. A decision will be made in the 3rd Quarter of FY97 as to whether to continue with one or both of these approaches.

It is anticipated that both devices will use 532 nm (green), diode pumped solid state lasers with 300 milliwatt peak power. There is, however, the possibility that they may use diode technology, if advancements are made in the near future. These lasers will be eyesafe in their intended mode of operations. The design goal is to have them be eyesafe at

aperture. They are similar to Phillips Laboratory's BOSS system but at a lesser power. Phillips Laboratory is in fact the JPSG's technical agent for this effort. Both these systems will have ranges of from 1 m to 50 m, depending on ambient lighting conditions. The lasers will be able to operate for 60 minutes without recharging with a duty cycle of .25 seconds on and .75 seconds off.

PYROTECHNIC DEVICES

An effort to develop enhanced, less lethal, faster acting, pyrotechnic devices, e.g., flash-bang and smoke grenades, is being undertaken as a joint development effort between Mattergy, Inc. of Phoenix, AZ and the U.S. Army Edgewood Research Development and Engineering Center (ERDEC). ERDEC is also acting as the JPSG's technical agent for this effort.

Mattergy is developing a less lethal stun grenade that is at least as effective as those currently on the market. Its approach to this effort is multi faceted. First, it will utilize pyrotechnic (non explosive), non toxic formulations. It will also employ a non-fragmenting canister and fuze, that vents in such a way as to result in a non propulsive grenade. Some of the non fragmenting designs on the market vent from the bottom. This may cause the grenade to be propelled forward after ignition, which may, in effect, create a hazardous projectile.

In addition to its role as technical agent for this effort, ERDEC is also developing pyrotechnic devices. Specifically, it is developing smoke/dazzler and acoustic (whistler)/dazzler grenades. Multi functional grenades are inherently more difficult to counter. ERDEC is pursuing development of fast bloom smoke, 1 - 3 seconds, and a number of possible approaches to dazzling, including strobes, flares and micro stars. The noise level of the pyro whistles, employed by ERDEC, can be controlled through the formulation of the composition and the geometry of the aperture. The pyro whistles have a 5 - 10 second duration. Both the Mattergy and ERDEC devices are intended to be hand-thrown, although there is a potential for grenade launcher compatibility.

ERDEC testing of its and Mattergy's devices will be completed in the 4th Quarter of FY96. This testing will include comparison of the characteristics of the Mattergy grenade against an off-the-shelf stun grenade.

ACOUSTIC STUDY

A study to determine the biological effects of acoustic energy in the infra sound and low audible range is being undertaken for the JPSG by the U.S. Air Force's Armstrong Laboratory. The goal of this effort is to provide the JPSG sufficient information to assess the potential utility of acoustic devices, operating within this range, for application to control of individuals and crowds. While there is indication that sound energy in this range will cause physiological effects that may be used to incapacitate individuals, there is insufficient hard evidence to attest to that. It is anticipated that this study will be completed by the end of FY96.

Summary

The basic goal of the LET program was to provide the user new, more effective tools to carryout their tasks. To that end the user communities—military, law enforcement and corrections—were heavily involved in both the development and articulation of their needs and in selection of the specific technology efforts to be pursued by the JPSG. Preliminary results from the demonstrations strongly suggest that this goal will be met.