ANNUAL REPORT 2009

ESCALATION-OF-FORCE OPTIONS

DEPARTMENT OF DEFENSE NON-LETHAL WEAPONS PROGRAM | HTTPS: // WWW.JNLWP.COM

DoD Non-Lethal Weapons Program

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USMC photo by Cpl Erin A. Kirk-Cuomo

"Warfighters must have the capability to respond using both lethal and non-lethal force ... Non-lethal weapon applications will provide new options for engaging personnel ..."

--General James T. Conway
Commandant of the Marine Corps
Executive Agent, DoD Non-Lethal Weapons Program

Non-Lethal Weapons

Necessary and Relevant Capabilities

America's forces have been heavily committed to contingency operations at home and abroad during 2009. Success in these operations demands that our military and our allies avoid innocent civilian casualties and unnecessary collateral damage while engaging an enemy who has chosen to intermingle with non-combatants.

Non-Lethal Weapons provide a necessary and relevant capability, applicable across a range of military operations, to complement lethal weapons and support escalation-of-force situations in today's operations. The prominence of non-lethal weapons in both United States and Allied operations continued to increase in 2009. In addition to a growing number of Joint and Service urgent need requests for non-lethal weapons, deploying units are now required to train with non-lethal weapons prior to deployment to overseas contingency operations. Combatant Commanders and Commanders at all levels have a clear understanding of the significant strategic, operational and tactical impact and value of non-lethal force application.

As you will see in this year's Annual Report, the Department of Defense Non-Lethal Weapons Program is committed to the development and fielding of precise, effective, longer range and lighter weight non-lethal weapons to meet warfighter requirements. This report captures highlights of program activities and actions underway in the development of directed energy, and kinetic weapons and munitions. The efforts described in human effects research, acquisition, requirements generation, science, technology, and non-lethal weapons training and education during the year will lay the foundation for achieving the improvements required to support our forces.

Lt. Gen. Thomas D. Waldhauser (Official USMC Photo)

Our Joint Force continues to be called upon to win our nation's wars and address a range of national security challenges. The Department of Defense Non-Lethal Weapons Program is committed to delivering flexible and effective non-lethal capabilities to help meet those challenges.

Lt. Gen. Thomas D. Waldhauser
United States Marine Corps
Chairman, Joint Non-Lethal Weapons
Integrated Product Team

Warfighters need non-lethal weapons, which will provide escalation-of-force options, minimizing civilian casualties and collateral damage.

iStockphoto

Non-Lethal Weapons

Operational Relevance

Department of Defense Directive 3000.3, Policy for Non-Lethal Weapons, defines non-lethal weapons as "Weapons that are explicitly designed and primarily employed so as to incapacitate personnel or material, while minimizing fatalities, permanent injury to personnel, and undesired damage to property and the environment. Unlike conventional lethal weapons that destroy their targets through blast, penetration, and fragmentation, non-lethal weapons employ means other than gross physical destruction to prevent the target from functioning."

Non-lethal capabilities provide escalation-of-force options for United States military forces. Today's increasingly complex operational environments require escalation-of-force capabilities that complement lethal weapons. They provide personnel with force application and force protection capabilities for use when lethal force is an undesirable first option.

Non-lethal weapons, devices and munitions enable military forces to avoid unnecessary casualties and minimize collateral damage to infrastructure. Although operational situations do not always progress from non-lethal to lethal force, non-lethal capabilities facilitate our ability to limit or control the escalation of violence when the use of lethal force could be either tactically or strategically counterproductive. This Annual Report will highlight the Department of Defense Non-Lethal Weapons Program's 2009 accomplishments and efforts, and outlines future non-lethal capabilities.

Combatant Commanders recognize the role that non-lethal weapons play in Cooperative Security, Irregular Warfare and Stability Operations. United States' forces are currently using non-lethal weapons for crowd control, detainee operations, checkpoint operations, convoy operations and area denial. For example, optical devices such as dazzling lasers have proven effective in safely providing warning to personnel approaching checkpoints and have reduced the number of civilian casualties at security checkpoints in the Central Command Area of Operations.

The following notional scenarios represent typical operations in which non-lethal weapons are used to effectively determine intent and respond with appropriate levels of force.

These scenarios illustrate the complex environment our military forces may face in current operations in remote communities, foreign ports and crowded urban centers where combatants may intentionally intermingle with civilians. Our Soldiers, Sailors, Airmen, Marines and Coast Guardsmen must quickly choose whether to use lethal force in uncertain situations with limited time and distance to determine the intent of individuals or groups. In many cases, the use of non-lethal weapons may provide our forces information to help them make critical choices or to resolve situations without resorting to lethal force. Non-lethal weapons provide them a better opportunity to achieve the mission without unnecessary fatalities, permanent injuries or damage to property.

Scenario 1:

Convoy Operations

A small military unit providing convoy escort and route security for a humanitarian relief supply mission spots a crowd of individuals blocking the road. The unit leader orders the convoy to slow down. He is aware of enemy tactics that mix combatants with non-combatants, which make it difficult to distinguish friend from foe. Based on a quick assessment, the unit leader determines that the crowd possibly includes a mixture of antagonistic demonstrators and onlookers. The unit leader uses an acoustic hailing device equipped with a translation apparatus to issue a warning to clear the road. However, the crowd shows no sign of dispersing. Some of the demonstrators in the crowd begin throwing rocks. Although he is eager to resume the convoy's operation, the unit leader is also keenly aware of the need to de-escalate the situation without harming innocent bystanders. Unit members fire non-lethal sting-ball grenades, which cause the crowd to disperse while avoiding civilian injuries and property damage. The convoy resumes and successfully delivers its humanitarian relief supplies.

Scenario 2:

Maritime Security

A surface combatant ship approaches a harbor entry channel for a port call. The crew observes a rusted fishing vessel approaching 1,000 meters off the ship's starboard side. The suspicious vessel continues its approach. The captain orders the bridge watch to employ an acoustic hailing device. The device's loud warning tones and voice commands cause the suspect vessel to slow its approach. The ship's security detachment then fires Non-Lethal Warning Munitions to deliver a warning using light, sound and smoke to deter the suspect vessel from coming closer. The combination of the warning munitions and the acoustic hailing device's intolerable sound compels the suspect vessel to change course.

Acoustic Hailing Device

Scenario 3:

Perimeter Control

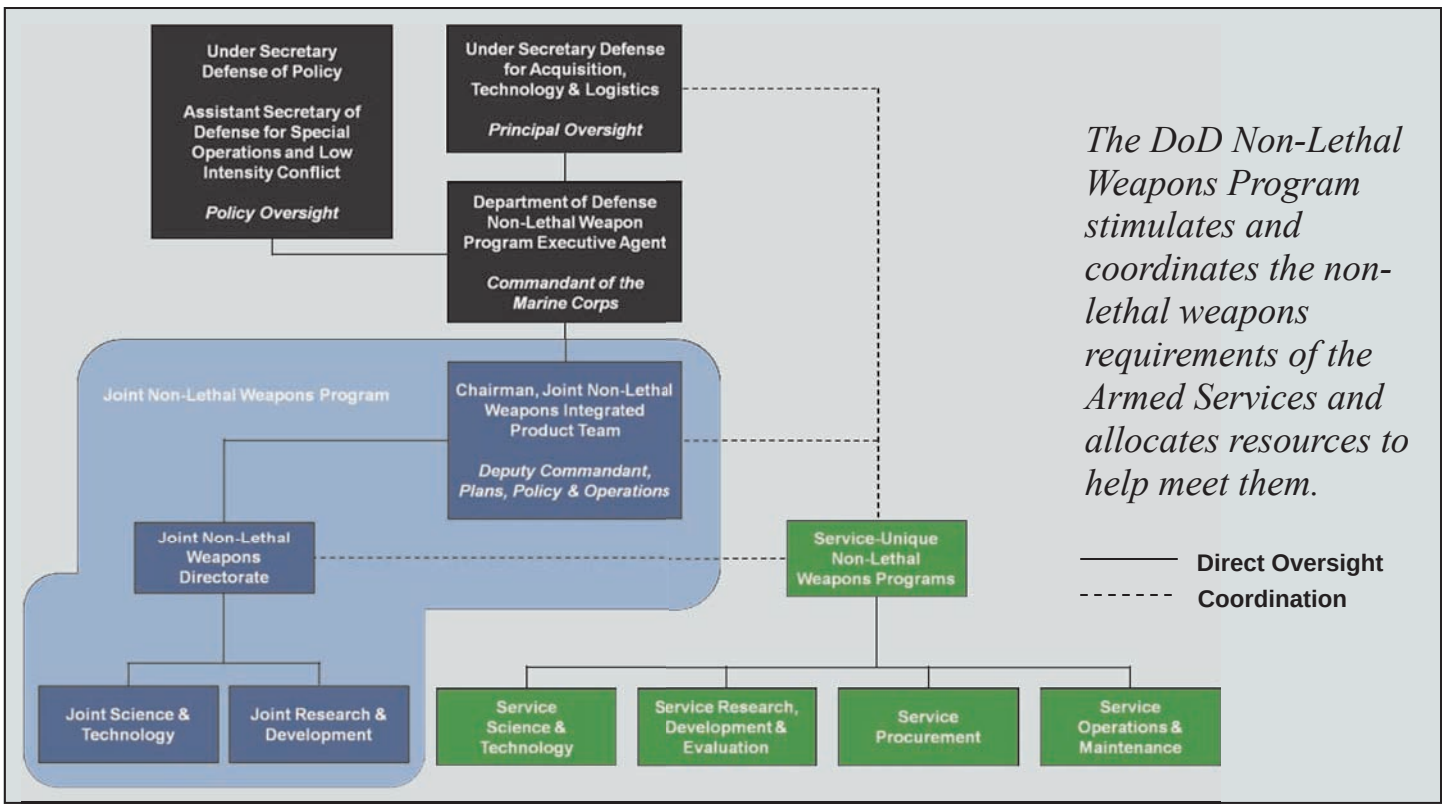
An infantry squad has set up a perimeter to protect military construction personnel rebuilding a village school. A small truck approaches the construction site. As the vehicle approaches the entry control point of the construction site, the driver fails to obey the posted signs instructing drivers to stop. Squad members suspect that the driver may not be complying because he is inattentive or does not understand the posted signs. They focus an eye-safe, non-lethal, green laser at the vehicle's windshield to optically distract and warn the driver to stop. However, the vehicle continues to advance until it encounters a pre-emplaced, reusable vehicle stopping net, called a Portable Vehicle Arresting Barrier. The Portable Vehicle Arresting Barrier successfully stops the vehicle.

Department of Defense Non-Lethal Weapons Program

In response to requests from Commanders in the field, in 1996 the Deputy Secretary of Defense released a memorandum implementing a Non-Lethal Weapons Program, and published Department of Defense Directive 3000.3. The Directive defined non-lethal weapons, established policy for use of non-lethal weapons and assigned the Commandant of the Marine Corps as the Executive Agent for the Department of Defense Non-Lethal Weapons Program. The Directive also assigned program oversight to the Under Secretary of Defense for Acquisition, Technology and Logistics and policy oversight to the Assistant Secretary of Defense for Special Operations/Low-Intensity Conflict.

The Department of Defense Non-Lethal Weapons Program stimulates and coordinates the non-lethal weapons requirements of the Armed Services and allocates resources to help meet them. The Services coordinate and work with the Combatant Commands and the Executive Agent through an established joint process to identify requirements and then plan, program and fund non-lethal weapons research, development and acquisition. Also within the larger Department of Defense Program, the Joint Non-Lethal Weapons Program supports the development of integrated and fully supported systems designed to give Commanders non-lethal escalation-of-force options. The Joint Non-Lethal Weapons Directorate, acting on behalf of the Executive Agent, serves as the Department's focal point for matters regarding non-lethal weapons.

The fiscal year 2009 Department of Defense Non-Lethal Weapons Program budget consisted of approximately $130 million of Joint Non-Lethal Weapons Program and Service funding. The $64 million in Joint Non-Lethal Weapons Program funding supported Joint research, development, testing and evaluation, and science and technology endeavors. Service funding was used to develop, purchase, operate and maintain current non-lethal weapons.



The DoD Non-Lethal Weapons Program stimulates and coordinates the non-lethal weapons requirements of the Armed Services and allocates resources to help meet them.

United States Soldiers from Alpha Company, 1st Battalion, 17th Infantry Regiment, 5th Brigade Combat Team, 2nd Infantry Division meet with a village elder in Dilak-e Pa'in, Afghanistan. (Official USAF Photo)

Combatant Command Mission Requirements

The Department of Defense Non-Lethal Weapons Program's efforts are driven by the requirements of United States operating forces. Today's increasingly complex and fluid military operations require a range of capabilities that give our forces the ability to minimize unintended casualties and collateral damage when appropriate. Non-lethal weapons provide such capabilities, offering our forces a complement to lethal weapons appropriate for a wide range of military operations; including irregular warfare, stability and support operations, and support to civil authorities. Consequently, non-lethal weapons will continue to provide escalation-of-force options within the range of military operations.

Combatant Commands recognize the military utility of non-lethal weapons and are incorporating them into their operational planning and guidance. Three of the Combatant Commands (United States Central Command, United States European Command and United States Joint Forces Command) have incorporated non-lethal weapons into their Integrated Priority Lists, with European Command mentioning non-lethal weapons as an enduring issue. Explicit or implied requirements for non-lethal capabilities rank high on Integrated Priority Lists.

Non-lethal weapons, as a complement to lethal weapons, provide the means to control escalation of hostilities in many situations and can help our forces maintain the "moral high ground," while enhancing population security and retaining force protection capabilities.

Initial Capability Documents

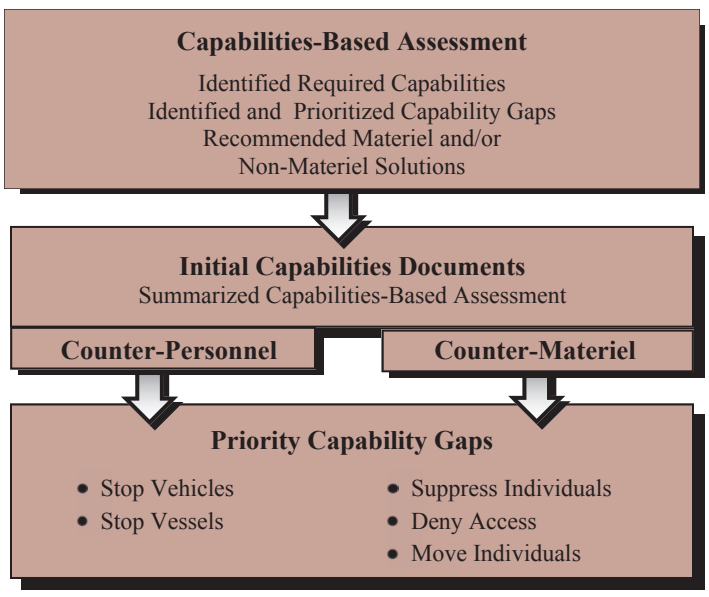
"…. It doesn't even matter if the enemy hides behind civilians. What matters are the death and destruction that result and the expectation that we could have avoided it. In the end, all that matters is that, despite our best efforts, sometimes we take the very lives we are trying to protect… You cannot defeat an insurgency this way."

--Adm. Michael Mullen
Chairman, Joint Chiefs of Staff

The Services develop non-lethal capabilities by reviewing warfighter requirements, assessing the requirements to determine and prioritize capability gaps and identifying non-lethal solutions to mitigate those gaps. The Department of Defense's non-lethal weapons capabilities are identified according to Chairman of the Joint Chiefs of Staff Instruction (CJCSI) 3170.01G, Joint Capabilities Integration and Development System. By analyzing scenarios and specific missions, all necessary capabilities are rigorously reviewed. When current resources cannot meet a requirement, the Joint Capabilities Integration and Development System process identifies, assesses and prioritizes materiel and non-materiel approaches to provide required capabilities.

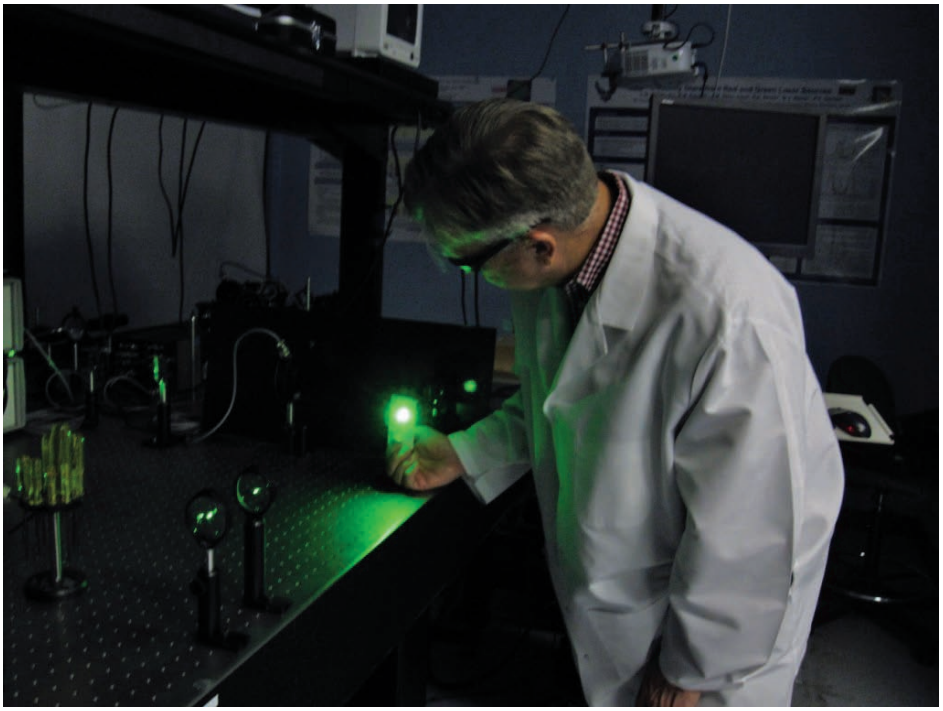
In April 2009, the Joint Capabilities Board approved the Initial Capabilities Documents for Counter-Personnel and Counter-Materiel Joint Non-Lethal Effects. The approval of these two key documents provides the foundation for future Joint and Service non-lethal weapons development and fielding. They will guide concept refinement and technology development of non-lethal capabilities and may be the source of one or more Capability Development Documents. The approved Initial Capabilities Documents also help focus research investments toward resolving non-lethal weapons capability gaps.

Additionally in 2009, work began on updating the Department of Defense Non-Lethal Capabilities Roadmap. The updated Roadmap will integrate the results of the Joint Non-Lethal Effects Capabilities Based Assessment, which was completed in 2008, allowing mapping of current and future non-lethal weapons to capability gaps. The Roadmap will serve as a framework for facilitating decision-making and management of the Department's integrated non-lethal weapons capabilities portfolio.



Human Effects

A Unique Requirement



Dr. Leon N. McLin aligns a laser to measure the glare effects of various dazzler systems on human test subjects. McLinn is the Senior Research Optometrist, Air Force Research Laboratory, Brooks-City-Base, Texas.

Non-lethal human effects are the physiological and behavioral responses produced by non-lethal weapons. Human effects research identifies a weapon's risk of significantly injuring a targeted individual and characterizes a technology's human effects "operating envelope." The desired non-lethal operating envelope spans between the threshold for intended or desired effects and the risk of significant injury.

Human effects research provides vital data, analyses and recommendations necessary to support legal, treaty compliance and policy reviews. A thorough human effects understanding is also central to the development of non-lethal weapons tactics, techniques and procedures.

Risk of Significant Injury Characterization

Understanding the risk of significant injury from a non-lethal weapon allows our commanders to make informed decisions regarding their use.

The DoD Non-Lethal Weapons Program is working to relate the risk of significant injury of a given non-lethal weapon to established Health Care Capability indices used by the medical community. Health Care Capability indices (zero, one or two) define the degree of care required for an injury. Injuries that are classified as level zero can be managed by basic first aid. A level one injury requires assistance from a trained medical professional. Level two injuries require advanced medical care.

In 2009, work began on a methodology that will use the results of human effects models to map the risk of significant injury of a given non-lethal weapon to a projected health care capability index. This effort will support the Services in their generation of non-lethal weapon Capability Development Documents and Capability Production Documents that the Department's formal acquisition process requires.

Current Efforts

In 2009, primary human effects research areas included Human Electromuscular Incapacitation Bioeffects, Blast Overpressure Effects Modeling, Radio-Frequency Bioeffects, and the Human Effects Modeling Analysis Program. These areas are described in more detail below.

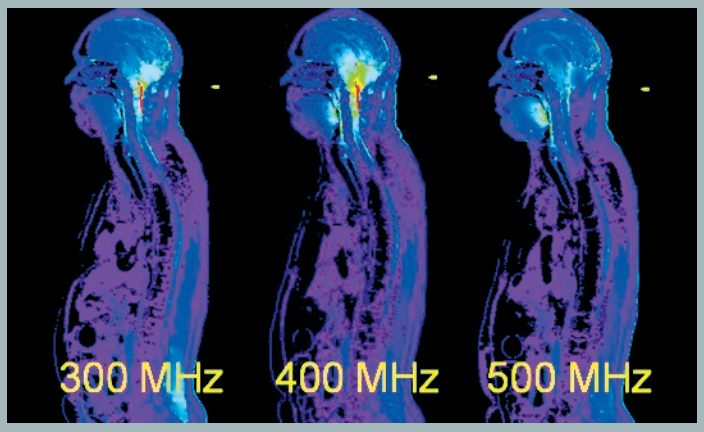
Human Electromuscular Incapacitation Bioeffects

Conducted energy devices such as electric stun guns emit electrical waveforms that disrupt the signal between the muscles and the nervous system, causing temporary loss of muscle control and posture. These devices provide our troops a means to non-lethally disable an individual, potentially preventing hostile action while preserving troop force protection.

The Human Electromuscular Incapacitation Bioeffects project is dedicated to understanding the science of this technology. The project evaluates commercial-off-the-shelf conducted energy devices to determine the biomechanisms of electromuscular incapacitation, define safety margins of stimulus exposure and assess the resulting physiological effects. In 2009, researchers continued work on a computer model that will support current and future assessments of conducted energy devices.

Blast Overpressure Effects Modeling

Some non-lethal weapons, such as flash-bang grenades, have a low-level blast overpressure component and therefore require testing and modeling to qualify risk of significant injury to the targeted individual. The Blast Overpressure Effects Modeling project investigates the effects of low-level blast overpressure and potential injury as it relates to non-lethal weapons. In 2009, researchers quantified the threshold of injury from low-level blast overpressure and developed an injury model. The project also began to model the shock wave component of low-level blast to further define the threshold of injury, expand risk curves and develop a three-dimensional model for overpressure effects. Research results were presented at the 2009 Society for Neuroscience Annual Meeting in Chicago, Illinois. Data from this project is also supporting the broader Department of Defense Blast Injury Research Program by defining the lowest level of non-impact blast exposure as it relates to or causes injury.



Radio-Frequency Bioeffect images depict radio frequency specific absorption rates with a human model.

Radio-Frequency Bioeffects

The safe use of radio-frequency directed energy to disable vehicles and vessels is of great interest to the DoD Non-Lethal Weapons Program. The Radio-Frequency Bioeffects project is focused on documenting the human effects safety of the radio-frequency waveforms that would be used in a future radio-frequency vehicle or vessel stopper capability. In 2009, researchers used field measurements, as well as modeling and simulation, to define areas of human effects risk based on current safety standards. The results show that a radio-frequency vehicle or vessel stopper can be built that will have minimal risk of injury to humans.

2009 Human Effects Progress:

- **Initiated development of methodology to map the risk of significant injury of a given non-lethal weapon to a projected health care capability index**
- **Continued work on a computer model that will support current and future assessments of conducted energy devices**
- **Quantified the threshold of injury from low-level blast overpressure and developed an injury model**
- **Used radio-frequency field measurements, as well as modeling and simulation, to define areas of human-effects risk based on current safety standards**

Technical Expertise

The DoD Non-Lethal Weapons Program uses Human Effects Advisory Panels and Technology Effectiveness Advisory Panels to conduct independent, subject matter expert assessments of non-lethal technologies and weapons programs. Each panel is composed of credentialed personnel with requisite human effects and technology effectiveness knowledge and pertinent expertise. These panels provide reports that address the status of knowledge and provide recommendations for additional human effects and effectiveness research.

Human Effects Advisory Panels focus on assessment of the Department of Defense's current human effects research plan as it relates to specific non-lethal weapons or technologies. Nanosecond electrical pulses and ultra short-pulsed lasers were areas examined by a Human Effects Advisory Panel in 2009. The Panel found that data from these research areas support future human electromuscular incapacitation research and made recommendations for a research path forward.

Technology Effectiveness Advisory Panels perform evaluations of effectiveness data, guiding concepts of operations, and tactics, techniques and procedures development in association with the non-lethal technology under review. A Technology Effectiveness Advisory Panel was established to review radio-frequency vehicle and vessel stopping efforts in 2009. The Panel made recommendations for both efforts related to program management, technical development and safety-related research.

A standing Human Effects Review Board provides Department of Defense medical and safety communities' analysis of risk associated with the human effects of non-lethal technologies and weapon systems. Board membership includes representatives from the offices of the Services' Surgeons General, the Medical Officer of the Marine Corps, and each Service's safety division. Conducting reviews prior to acquisition milestone decisions, the Human Effects Review Board reports on known human effects risks and recommends actions necessary to further quantify those risks or to mitigate them. Programs reviewed in 2009 include the Improved Acoustic Hailing Device, Vehicle Lightweight Arresting Device and the Mission Payload Module. The Board found the programs well characterized and that human effects research is sufficient to proceed to Milestone C.

The assessments and recommenddations provided by the Human Effects Review Board, as well as the Human Effects Advisory Panel and Technology Effectiveness Advisory Panel, are essential to the advancement of non-lethal technologies and the understanding of risk associated with the effects of those technologies on humans.

Independent Review Panels
Supporting Development and Advancement of Non-Lethal Technologies

Human Effects Advisory Panels
- Non-government independent board of subject matter review experts
- Review technology research plan as related to specific non-lethal technology
- 2009 Efforts: nanosecond electrical pulses and ultra short-pulsed lasers

Technology Effectiveness Advisory Panels
- Independent subject matter experts
- Evaluate effort on data and operational procedures
- 2009 Efforts: radio-frequency vehicle and vessel stopping efforts

Human Effects Review Board
- Representatives from the Services' Surgeon General, the Medical Officer of the Marine Corps and each Service's safety division
- Independent government review in advance of each acquisition milestone
- 2009 Efforts: the Improved Acoustic Hailing Device, Vehicle Lightweight Arresting Device and the Mission Payload Module

Current Capabilities

The United States Military continues to enhance its capabilities to preempt asymmetric methods of warfare used by our adversaries. This includes a need for increased escalation-of-force options.

The DoD Non-Lethal Weapons Program looks to fulfill non-lethal capability gaps and expand escalation-of-force options in several ways, including responding to Combatant Commander's urgent needs and assisting the Services with the development of new non-lethal weapon capabilities.

The following sections describe progress in the fielding of non-lethal weapons and highlight activities in 2009 that supported fulfillment of urgent warfighter needs or contributed to development of new and emerging non-lethal weapons.

Non-Lethal Capability Sets

Several Services are using customized non-lethal capability sets to provide our forces a variety of escalation-of-force options. These customized sets contain versatile modules and sub-modules of non-lethal weapons, devices and munitions. Each Service tailors the contents of the sets to their individual Service needs. The United States Central Command emphasized the importance of these capabilities in 2009 when it mandated non-lethal weapons training as a prerequisite for forces deploying into Central Command's area of operation.

Several of the Services increased their fielding of non-lethal capability sets in 2009:

- U.S. Army fielded 40 sets to Brigade Combat Teams
- U.S. Marine Corps fielded 63 sets, along with 126 Anti-Terrorism/Force Protection Checkpoint Sets
- U.S. Air Force Security Forces provided sets at 24 locations in Southwest Asia

Current Capabilities

Acoustic Devices

Acoustic devices provide improved communication and warning options in open, urban and maritime operations. These devices enable our operational forces to communicate, at range, in either real-time voice or with pre-recorded, multiple-language messages. They can also project attention-getting, highly irritating tones, which may help to deter or modify an individual's behavior. These devices have been helpful in checkpoint, convoy and maritime applications. The Navy equipped several ships, submarines, and aircraft carriers with acoustic warning devices in response to an urgent operations needs statement during 2009. The Marine Corps has added acoustic hailing devices to their Non-Lethal Capability Sets. Also in 2009, the Army successfully conducted required assessments and demonstrations to complete a Capability Production Document, enabling an anticipated Milestone C decision in early 2011.

An instructor demonstrates a commercial-off-the-shelf translation device, which is part of the Army's Non-Lethal Capability Sets. Such devices enable our operating forces to enhance communications with local populations in Iraq and Afghanistan.

Acoustic Hailing Device


LA-9/P Effect

Non-lethal dazzling lasers are different than target acquisition lasers.

The dazzling lasers provide a safe, tested nominal ocular hazard distance, providing an obvious non-verbal warning.

In 2009, engineering safety control modules were designed that would ensure protection of the eye, even within minimum safety distances.


LA-9/P

Dazzling Lasers

Dazzling lasers continue to prove their value in Iraq and Afghanistan. These non-blinding dazzling lasers temporarily overwhelm a target's visual senses using directional light energy to provide an obvious non-verbal warning. These devices have been especially helpful at vehicle checkpoints and in convoy operations when drivers have failed to follow other signals to slow down or stop.

All optical distracters undergo extensive human effects testing to determine at what distances they are safe to use without causing permanent eye damage. To further increase the safety of these dazzling lasers, in 2009 engineering safety controls were designed that would ensure protection of the eye, even within minimum safety distances.

The Marine Corps began retrofitting a previously fielded green laser with these safety control modules. The modified green laser, known as the LA-9/P, prevents inadvertent lasing by reducing power or shutting off the system when a target enters the minimum eye-safe distance. Due to the demonstrated operational value of these devices, a formal acquisition program was established. The formal program will continue to advance the capability of dazzling lasers by developing a system that is eye-safe at the aperture and effective out to 500 meters.

In 2009, the Navy also procured approx. 700 LA-9/Ps in response to a Joint Urgent Operational Needs Statement for Vessel Stopping. The Navy plans to use these devices as warning systems to determine intent of potentially dangerous individuals or vessels, as well as to alert local populations that Naval forces are operating in the area.

Near-Term Capabilities

As part of its mission to outfit our troops with enhanced escalation-of-force capabilities, the Department of Defense Non-Lethal Weapons Program coordinates efforts among the Services and assists them in fielding non-lethal weapons based on identified requirements. The non-lethal capabilities described in the following section are advancing through the formal acquisition process and will be available for Service procurement in the near-term.

Airburst Non-Lethal Munition

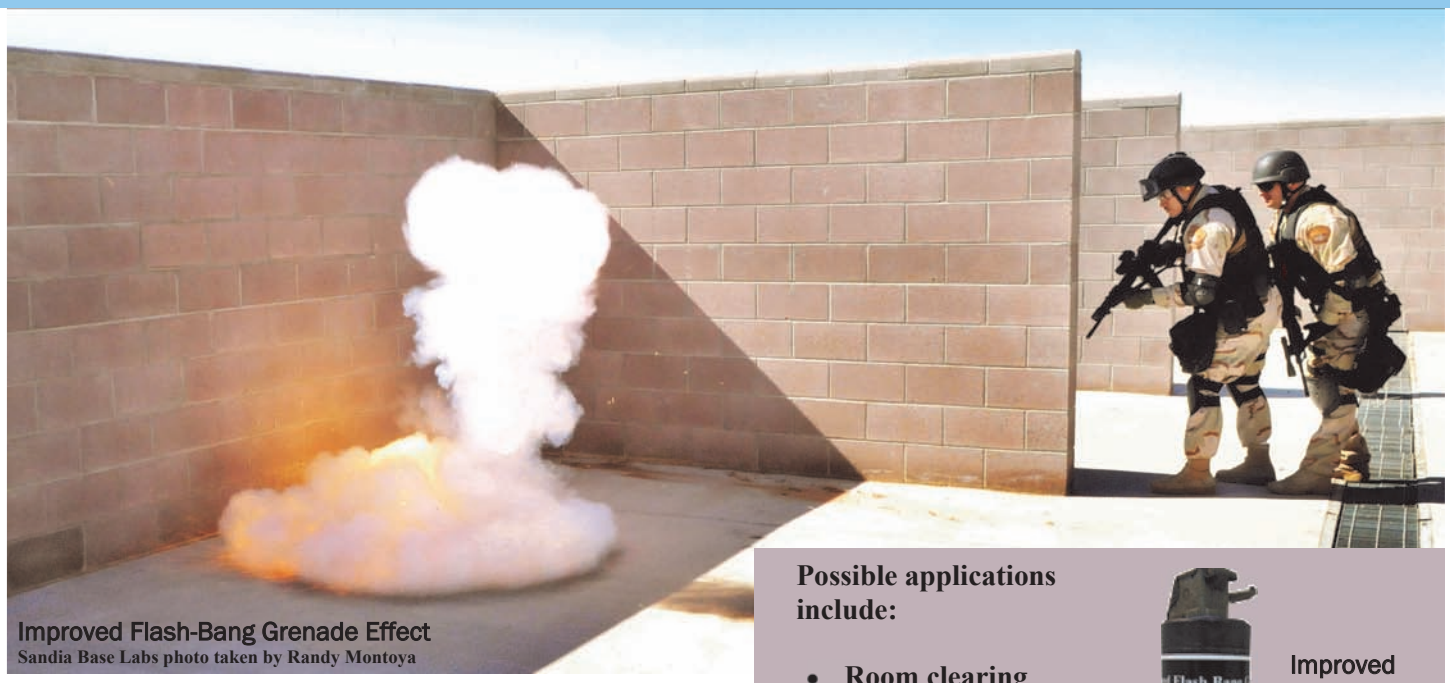
The Airburst Non-Lethal Munition achieved a successful Milestone B decision in 2009, moving it into the Engineering and Manufacturing Development phase of the acquisition process. This non-lethal munition is a counter-personnel, 40 mm, low-velocity projectile designed to move, deny or suppress individuals or groups with a warning/incapacitating flash-bang.

Fired from M203, M320 or M32 grenade launchers, the Airburst Non-Lethal Munition is designed to release a flash-bang payload at a safe distance from its target. To do this, it incorporates an advanced proximity fuse that senses the distance from the target, detonates the payload before reaching the target and uses back-blast to slow the casing to non-lethal velocities. Since the Airburst Non-Lethal Munition is effective beyond small-arms range, it will provide warfighters with additional non-lethal capabilities over hand-thrown flash-bang grenades. At the same time, the munition incorporates advanced fusing technology to keep users and non-combatants safe at closer ranges.

Possible applications include:

- **Checkpoint Security**
- **Crowd Dispersal**
- **Room Clearing Scenarios**

Airburst Non-Lethal Munition



Improved Flash-Bang Grenade Effect
Sandia Base Labs photo taken by Randy Montoya

Possible applications include:

- **Room clearing**
- **Hostage rescue**
- **Other operations in complex urban terrain**

Improved Flash-Bang Grenade

Joint Non-Lethal Warning Munition

The Joint Non-Lethal Warning Munition provides an unambiguous warning to approaching vehicles, vessels or personnel. It emits a loud bang, bright light and smoke. Each munition includes a time-delay fuse that enables it to detonate at fixed ranges. The Joint Non-Lethal Warning Munition is intended for use with either a 12-gauge shotgun or 40 mm grenade launcher. The currently fielded 12-gauge cartridges are either 100 or 200-meter variants. The Navy fielded the 12-gauge Joint Non-Lethal Warning Munition in 2009, and the Coast Guard will begin fielding in 2010. The 40 mm cartridges have ranges of 100, 200 or 300 meters and are under development for potential fielding. The 40 mm Joint Non-Lethal Warning Munition received Weapons Systems Explosive Safety Review Board concurrence for Initial Operational Capability and Safety Release in 2009 as an Abbreviated Acquisition Program.

Improved Flash-Bang Grenade

The Improved Flash-Bang Grenade creates a loud bang and a large, bright, long-duration flash to temporarily incapacitate the hearing and vision of targeted individuals. The grenade is also intended to have reduced environmental toxins and improved safety for the user. This non-lethal grenade will support missions such as room clearing, hostage rescue and other operations in complex urban terrain. After receiving a Milestone B decision in 2008, the program entered the Engineering and Manufacturing Development phase of the acquisition process. In 2009, several potential material solutions were evaluated for their ability to meet the documented requirement.

Improved Acoustic Hailing Device

The Improved Acoustic Hailing Device is a developmental non-lethal, counter-personnel, long-range hailing and warning device. This device includes increased range and voice intelligibility, even with significant background noise at the target location, enabling our operating forces to more effectively communicate with crowds, vessels or vehicles at increased distances. In 2009, the Improved Acoustic Hailing Device program achieved several objectives required for a Milestone C decision.

Emerging Capabilities

Developing and fielding non-lethal weapons that fully meet the needs identified in the Joint Non-Lethal Effects Capabilities Based Assessment, in several cases, will require dedicated science and technology research and accompanying technological advancements. The following section highlights several projects that are underway with the goal of bringing advanced non-lethal capabilities to our forces.

Radio-Frequency Vehicle Stopper

Vehicle stopping is the highest-priority Joint Non-Lethal Effects capability gap. Our forces want a non-lethal capability to stop vehicles at long ranges in support of checkpoint and entry control point missions. To address this need, the Radio-Frequency Vehicle Stopper - Multi-Frequency project is developing a prototype system that uses high-power radio-frequency energy to interfere with a vehicle's engine sensors and electronics, causing the engine to stop. The goal is to develop a system where the effect persists as long as the radio-frequency beam remains on the targeted vehicle, with the engine being able to be restarted once the beam is turned off.

The Radio-Frequency Vehicle Stopper - Multi-Frequency project made several advancements during 2009. Three large, threat-representative vehicles (one truck and two tractor-trailers) were procured as test items. Using a breadboard design, researchers demonstrated the capability to stop vehicles at ranges greater than 100 meters. The project also obtained high-power magnetrons for future testing that will include use of military checkpoint scenarios.

Vehicle stopping is the highest-priority Joint Non-Lethal Effects capability gap.


Active Denial System

Active Denial Technology

Active denial technology holds tremendous potential to provide operating forces with a non-lethal option to stop, deter and repel suspicious individuals. Applications include: perimeter security, crowd control, convoy protection, port security and entry control point security.

This state-of-the-art technology projects a focused beam of millimeter waves to induce an intolerable heating sensation on an individual's skin, repelling the individual with minimal risk of injury. More than a decade of research has established active denial technology's biological and behavioral effects for large-scale beam spot sizes. Two large-scale ground-based active denial systems were built and demonstrated as part of a Department of Defense Advanced Concept Technology Demonstration program.

In 2009, research continued on understanding the effectiveness of smaller-scale beam spot sizes. If smaller beam spot sizes prove effective, then it may be possible to develop a next-generation active denial system that is more compact, less expensive and less complex than current technology. Research is underway on new millimeter wave sources that will require less power, but deliver the same active denial "repel" effect.

Active Denial System

- Non-lethal, counter-personnel, directed energy weapon
- State-of-the-art technology
- Provides U.S. operating forces a revolutionary non-lethal capability
- Will reduce unnecessary causalities and collateral damage
- Directed energy produces invisible millimeter waves at a frequency of 95 GHz
- Directed energy travels at the speed of light
- Reaches a skin depth of 1/64th of an inch, equivalent to three sheets of paper
- Produces an intolerable heating sensation
- Effects are temporary and reversible
- Years of research—minimal risk of injury
- System incorporates many safety features to prevent over-exposure or misuse

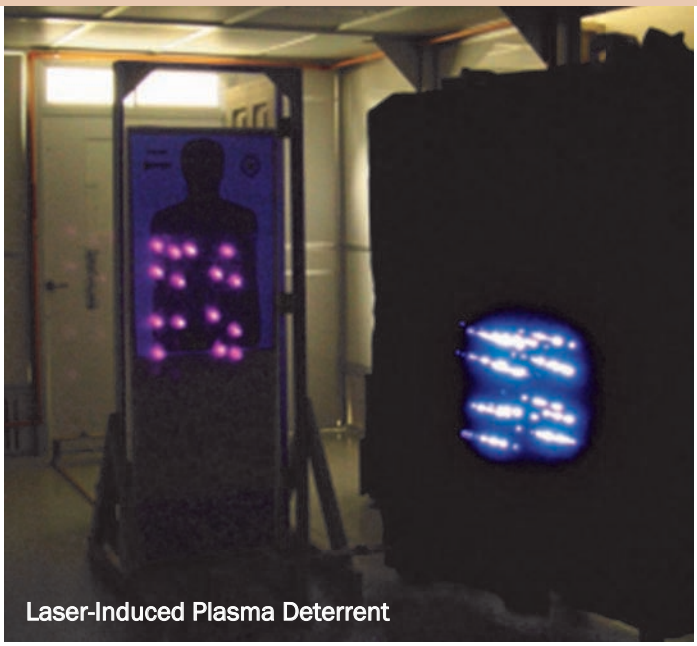
Emerging Capabilities

Laser-Induced Plasma Technology

Another prospective non-lethal technology uses retina-safe lasers to create plasma bursts. Known as Laser-Induced Plasma, this technology has the potential to produce advanced counter-personnel optical and acoustic warning effects that can potentially deny or move targeted individuals from an area by creating a "wall" of plasma bursts.

This technology works by using low-power lasers that generate extremely high peak powers for fractions of a second that ionize the air, creating a short, loud sound and flash.

During 2009, research proceeded on characterizing and measuring acoustic, optical and thermal effects, as well as the shock impulse generated when ionizing the air. Researchers also developed a computer program to predict the audible signals produced by multiple bursts over different spatial orientations.



Laser-Induced Plasma Deterrent

Combined Sound and Light Effects

Moderate-intensity sound and light, used independently, have proven effective in hailing, warning and deterring suspicious individuals. When used together, they can create a more dramatic effect. To further evaluate the military utility of combined sound and light effects further, the DoD Non-Lethal Weapons Program developed a vehicle-mounted technology demonstrator known as the Distributed Sound and Light Array. This technology demonstrator combines directional high-output sound with bright, white lights and a non-lethal green laser. The sound array conveys specific instructions to the target while the light array attracts attention.

In 2009, Institutional Review Board approval was received for field studies on human subjects. These field studies are being analyzed to assess the effectiveness of combined sound and light effects in numerous scenarios at extended ranges, including vehicle- and vessel-stopping missions.

Distributed Sound and Light Array effects safely experienced by vehicle occupants.

Inter-service Non-lethal Individual Weapons Instructor Course students practice firing non-lethal munitions.
(Official DoD Photo)

Enhancing Non-Lethal Weapons Knowledge

Training

United States Central Command's May 2009 decision to mandate non-lethal weapons training as a prerequisite for forces deploying to its area of operations, was an important milestone for the non-lethal weapons training community. Non-lethal weapons training is conducted primarily through the Inter-service Non-lethal Individual Weapons Instructor Course at Fort Leonard Wood, Mo. This course teaches Service members to instruct others in the use of non-lethal weapons. Approx. 370 trainers graduated from the course in 2009, a 12 percent increase from 2008.

Students attend the 10-day course to gain knowledge of various non-lethal weapons and accompanying tactics, techniques and procedures. The course teaches students how non-lethal weapons can complement lethal weapons in escalation-of-force scenarios. Training culminates with exercises that test each student's instructional capabilities, decision-making skills and ability to integrate non-lethal weapons into applicable operations. After course completion, the certified trainers return to their units to train others on the use of non-lethal weapons.

The course also provides Mobile Training Teams that travel to unit locations to provide on-site training. In 2009, training teams provided instruction at multiple locations preparing Army, Army Reserve and Army National Guard units for operational deployments.

Education

Opportunities for formal education on non-lethal weapons are available through several venues. The Air War College, National Defense University, Industrial College of the Armed Forces and the Marine Corps Command and Staff College offer an elective course entitled, "Non-Lethal Weapons: Support to 21st Century Warfare and Homeland Defense." Pennsylvania State University facilitated the course under a contract with the Joint Non-Lethal Weapons Directorate. The comprehensive course included lectures from recognized subject matter experts and current program managers on non-lethal weapons and technologies, the incorporation of non-lethal weapons into military doctrine and strategy, operational use of non-lethal weapons, human effects, legal and treaty compliance reviews.

Independent study, either online or via DVD, was also offered under a contract with Pennsylvania State University. The self-paced course entitled, "Non-Lethal Weapons: Policies, Practices and Technologies Certificate Program," offered participants the opportunity to learn about non-lethal weapons and apply decision-making skills to real-world operations. Ongoing updates and revisions to the course have enhanced its effectiveness and realism.

Enrollment has steadily increased since the course's inception in 2005. More than 3,200 students have enrolled in the course to date. This year, links to the non-lethal weapons course were posted on Navy Knowledge Online, MarineNet and the Air Force Portal to increase awareness and encourage service members to enroll and complete the course.

Global Reach

Building cooperative relationships with other nations supports United States strategic interests. The Department of Defense Non-Lethal Weapons Program actively pursues opportunities to share non-lethal weapons information with partner nations.

Ongoing efforts with the geographical Unified Combatant Commands and the North Atlantic Treaty Organization allow multiple opportunities for increased awareness of non-lethal weapon capabilities and integration into ongoing operations.

Security Cooperation

Unified Combatant Commands host and participate in exercises with other nations each year and use of non-lethal weapons in these events has increased. The Department of Defense Non-Lethal Weapons Program sponsored Combatant Command Liaisons Officers provide non-lethal weapons expertise during planning and execution of these international exercises.

Joint Forces Command's Unified Endeavor exercises serve as mission rehearsals for Joint Task Force staffs preparing for operational deployments. Joint Forces Command holds at least three independent, annual exercises for Operation Enduring Freedom, Operation Iraqi Freedom and operations in the Horn of Africa. In 2009, Allied nations that participated were Afghanistan, Australia, Canada, Denmark, France, Germany, Iraq, Poland, Romania, Netherlands, Republic of Korea and the United Kingdom.

Non-lethal weapons were first integrated into Unified Endeavor in 2008 and during 2009 Joint Forces Command continued to develop scenarios for the exercises. The scenarios now include both rules-of-engagement and use-of-force training, which require staffs to consider non-lethal weapons in escalation-of-force situations.

In August 2009, European Command and Africa Command collaborated to host a Non-Lethal Weapons Conference and Capabilities Exercise near Stuttgart, Germany. The conference included discussion of each command's non-lethal weapons program and policies. Vendor displays

and non-lethal weapons familiarization demonstrations provided hands-on experience to exercise attendees including representatives from Angola, Benin, Cameroon, Gabon, Germany, Macedonia, Malawi, Morocco, Nigeria, Rwanda, Senegal and Tanzania.

Africa Command's Natural Fire exercise, conducted during October 2009 in Uganda, provided an opportunity to highlight the use of non-lethal weapons in peacekeeping operations. During Natural Fire, non-lethal weapons experts from the United States Army Southern European Task Force spent a week providing training for peacekeeping operations. Team leaders introduced crowd-dynamics and crowd-control formations to participants. Students learned how to control vehicle entry points and instructors demonstrated use of various non-lethal munitions and vehicle stopping devices. Representatives from Burundi, Kenya, Rwanda and Tanzania also participated in the exercise.

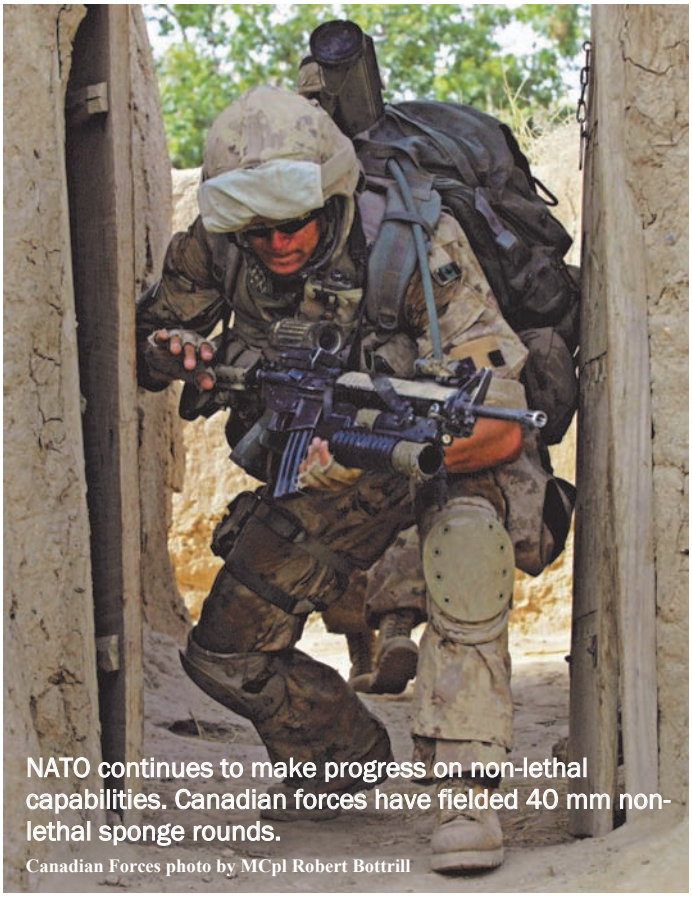
NATO Activities

The North Atlantic Treaty Organization has a long-standing interest in non-lethal weapons. In 2009, NATO continued to make progress on two non-lethal capabilities planning initiatives.

NATO has initiated a Capabilities-Based Assessment, chaired by the Director, Joint Non-Lethal Weapons Directorate. The assessment will analyze NATO's non-lethal weapons requirements, comparing current and planned capabilities against requirements to determine non -lethal weapons capability gaps and allowing for the identification and prioritization of potential non-materiel and materiel solutions for these gaps.

The Non-Lethal Weapons Defense Against Terrorism Initiative was also established by NATO in response to a request for non-lethal weapons from the Commander of the International Security Assistance Force in Afghanistan. The goal of this initiative is to identify near-term non-lethal weapon capabilities that could address terrorist threats in complex environments.

NATO conducted several other non-lethal weapons activities during 2009. In April, the NATO Undersea Research Centre hosted a workshop on non-lethal weapons options for port protection, which drew Conference of National Armaments more than 70 operational, industrial and research personnel from 12 nations. In June, the



NATO continues to make progress on non-lethal capabilities. Canadian forces have fielded 40 mm non-lethal sponge rounds.

Canadian Forces photo by MCpl Robert Bottrill

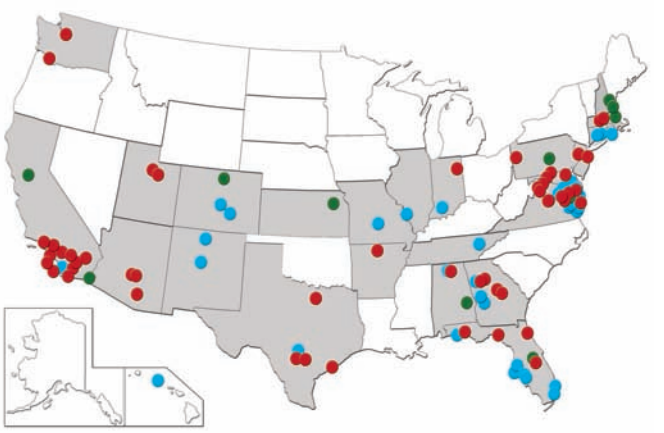
Directors hosted a meeting of specialists at NATO headquarters in Brussels, Belgium to discuss potential non-lethal weapons applications for NATO's anti-piracy efforts off the Horn of Africa. From late January to early February NATO units joining the Kosovo Force, including soldiers from the California Army National Guard, received non-lethal weapons training prior to deploying to Kosovo. In October, an additional Army National Guard Brigade, two Slovenian Companies and one Ukrainian Company also received non-lethal weapons training prior to deployment to Kosovo.

2009 NATO Non-Lethal Efforts:

- **Pre-deployment non-lethal weapons training for NATO units joining Kosovo Force**
- **Anti-piracy forum**
- **NATO Undersea Research Center Workshop**
- **Conference of National Armaments**
- **Continuous progress on Capabilities-Based Assessment and Non-Lethal Weapons Defense Against Terrorism Initiative**

United States Partnerships

The Department of Defense Non-Lethal Weapons Program's partnership with academia, government agencies and industry, leads to technological solutions for identified non-lethal weapons capability gaps. Educational efforts, scientific research and technological development focus on counter-personnel and counter-materiel solutions. On-going efforts explore and develop operationally suitable and effective escalation-of-force options for warfighters. These partnerships also facilitate other agencies' related research pursuits.



Academia

Auburn University
Kansas State University
Old Dominion University
Pennsylvania State University
Tufts University
University of California
University of Colorado
University of Florida
University of New Hampshire

Government Agencies

Aberdeen Proving Ground
Air Force Research Laboratory
Air Force Security Force Center
Army Infantry School Maneuver Center of Excellence
Edgewood Chemical Biological Center
Eglin Air Force Base
Fort Leonard Wood
Los Alamos National Laboratory
Naval Expeditionary Combat Command
Naval Medical Research Unit
Naval Surface Warfare Center
Naval Undersea Warfare Center
Picatinny Arsenal
Soldier Battle Lab
U.S. Africa Command
U.S. Army Combined Arms Support Command
U.S. Army Training and Doctrine Command
U.S. Central Command
U.S. Coast Guard Research and Development Center
U.S. European Command
U.S. Joint Forces Command
U.S. Naval Research Laboratory
U.S. Northern Command
U.S. Pacific Command
U.S. Southern Command
U.S. Special Operations Command
U.S. Transportation Command

Industries

ALS Technology, Inc.
ATK Thiokol
Aardvark Tactical
American Technology Corporation
BAE Systems
B.E. Meyers
Beretta
Combined Systems, Inc.
Conceptual MindWorks, Inc.
CPI Malibu Research
DRS Technologies, Inc.
Envisioneering, Inc.
Eureka Technologies, LLC
FATS, Inc.
FN Herstal
General Dynamics Ordnance and Tactical Systems
IML Corporation
Integrated Wave Technologies
Intelligent Optical Systems, Inc.
iRobot Corp.
Kongsberg Defense & Aerospace
L-3 Communications/Jaycor
Lockheed Martin
Lumenyte
Mechanical Solutions, Inc.
MEI Technologies
Metal Storm Limited
Milkor USA, Inc.
nLIGHT
Non-Lethal Solutions International, Inc.
Northrop Grumman Corporation
NP Photonics, Inc.
Paulson Manufacturing
Pelican Products, Inc.
PM & AM Research
Pyrotechnic Specialties, Inc.
QinetiQ Ltd.
Radiance Technologies, Inc.
Raytheon Company
Rheinmetall Defence
Safari Land, LLC
SAVIT CORPORATION
Southwest Research Institute
STINGER Spike Systems
SureFire, LLC
TASER International, Inc.
TigerLight, Inc.
Wattre Corporation
Xenonics Holdings, Inc.

Broad Area Announcements are listed on:

https://www.jnlwp.com

The above is a partial listing and illustration of institutions, agencies and industries, and is subject to change.

Non-Lethal Weapons

Assist in Reducing Civilian Casualties

During the past decade, the DoD Non-Lethal Weapons Program has continued to evolve to meet the challenges faced by the U.S. Armed Forces and the U.S. Coast Guard. With the attacks on this nation on September 11, 2001, the need for non-lethal capabilities has increased significantly even in a largely kinetic fight. Today's deployments necessitate that we intermingle with the local population on a daily basis. The dynamic Irregular Warfare conditions we face drive us to focus on the local populations, providing a secure environment and isolating them from insurgents. Non-lethal weapons can assist in reducing civilian casualties, while providing a measure of protection to our forces in uncertain situations.

Advancements have been made in the past year in procurement funding and fielding of new or improved non -lethal systems to our operating forces. Additional requirements, both programs of record and urgent needs, continue to be identified. These requirements are being addressed by the Services, SOCOM and the Coast Guard with the assistance of the Joint Non-Lethal Weapons Directorate. Aiding in this effort is a signed Joint Capabilities Document that acts as a spring board in the Joint Capabilities Integration Development System process for the Services to utilize.

Much work is yet to be done. We must grow our capability by increasing our non-lethal industrial base using wise technology investment strategies that transition to Service programs of record. Harmonizing projects to address identified priority gaps, informing our needs to our industry partners and well-timed coordinated transition are essential to our future success. Materiel solutions alone are not the answer. We must also improve our training of non-lethal weapons and devices during pre-deployment training escalation-of-force continuum scenarios. Well equipped and trained forces that can think through complex situations are the keys to success.

Colonel Tracy J. Tafolla (Official USMC Photo)

I look forward to meeting future challenges and assisting the Services, SOCOM and the Coast Guard in providing our forces value-added non-lethal solutions. Please feel free to contact our Joint Non-Lethal Weapons Program team listed below.

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The Department of Defense Non-Lethal Weapons Program provides our operating forces escalation-of-force options minimizing casualties and collateral damage. The DoD NLW Program supports research, development, test, evaluation, procurement, deployment and employment of NLW.

ESCALATION-OF-FORCE OPTIONS

DEPARTMENT OF DEFENSE NON-LETHAL WEAPONS PROGRAM
HTTPS: // WWW.JNLWP.COM