



JNLWP

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Joint Non-Lethal Weapons Program Newsletter

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Directed Energy and Non-Lethal Weapons: Past, Present and Future Technologies



Depiction of the Greeks focusing sunlight with mirrors during the Siege of Syracuse, using the sun's energy to set fire to the sails of the approaching Roman fleet.

Painting by Giulio Parigi

Many people think of directed-energy weapons as a technology of the future. But according to the history books, directed-energy weapons date back more than 2,000 years. Some historians date the first use of directed energy as a weapon to 212 B.C. during the Siege of Syracuse, when a Greek general focused sunlight with mirrors, setting fire to the sails of the Roman fleet. Whether the story is fact or fiction, historians agree that mathematicians and scientists studied, researched and developed the first energy-harnessing concepts during that ancient era.

Since then, directed-energy weapons have progressed to today's cutting-edge technologies. Directed-energy weapons emit focused energy in an aimed direction without the means of a projectile, transferring energy to a target for a desired effect. Today's directed-energy weapons include lasers, high-power microwaves, high-power millimeter waves and advanced optics.

Directed-energy weapons are beginning to pique the interest of the international defense community, according to Susan

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CALENDAR OF EVENTS

- 16-17 June:
U.S. Army ICT Meeting
- 7 July: JNLWD Change of Directorship and Retirement Ceremony
- 8-9 July: Radio-Frequency Vehicle and Vessel Stopping Technology Effectiveness Advisory Panel
- 10-12 August: Directed Energy Test and Evaluation Conference
- 25-27 August:
JNLWP Training Days
- 9-10 September:
Central Action Officers Meeting



Directed Energy and Non-Lethal Weapons *(continued from page 1)*

LeVine, Principal Deputy for Policy and Strategy for the Joint Non-Lethal Weapons Directorate.

“In many ways, the Joint Non-Lethal Weapons Program (JNLWP) is leading the way for the international introduction of non-lethal weapon directed-energy capabilities,” LeVine said. “The U.S. is far in front in terms of directed-energy weapon development.”

The 2009 Directed Energy Weapons Conference, held recently in London, England, provided an international stage for discussion of the latest directed-energy weapon developments. The annual conference focuses on the technological advances and policy challenges surrounding directed-energy weapons.

“The conference addressed the opportunities and possibilities of directed energy,” said conference presenter Dr. Greg Schneider, NATO Research and Technology Agency Director and the agency’s in-house expert on directed energy. “But the conference also confronted the challenges both technically and politically in their development and application.”

The conference’s international presentation panel and audience included leading directed-energy experts from the military, scientific community and industry from France, Belgium, the United Kingdom, the Netherlands, Germany, Canada, the United States and many others.

“There is international interest in directed-energy weapons, and very good scientific work is going on in many places,” said Schneider.

Conference presenters and attendees zeroed in again and again on one directed-energy weapon in particular: the Active Denial System (ADS).

During the conference, LeVine gave a presentation about the ADS, one of the U.S. military’s developmental directed-energy weapons. The ADS uses a non-lethal focused beam of millimeter waves to induce an intolerable heating sensation on an adversary’s skin, repelling the individual with minimal risk of injury.

“ADS was the most talked about technology at the conference,” LeVine said. “Specifically, there was high interest in Active Denial Technology and possible naval applications.”

LeVine noted that research on Active Denial Technology is ongoing. “While much has been accomplished in developing and demonstrating the ADS technology, much more remains to be done, particularly in reducing the size, weight and cost of key ADS components,” LeVine said. “The JNLWP is working to carry out this effort.”

Schneider, who has a long history of involvement with the ADS, says he is anxious to see it deployed and employed. “I consider it a pathfinder for directed-energy weapons and non-lethal weapons,” he said. “ADS will challenge people’s thinking. But I am confident it will be a very positive addition to the quiver of the operational commander.”

In the meantime, the world waits to see what directed-energy weapons have in store for the future.

—BY JENNIFER BOWEN



The Active Denial System
Official DoD Photo



COBRA GOLD 2009 Features Non-Lethal Weapons

The Joint Non-Lethal Weapons Program (JNLWP) recently participated in COBRA GOLD 2009 (CG09), a joint, multinational training exercise in Thailand. The annual exercise promotes multinational interoperability and provides training for U.S. partner nations. CG09's main participating nations included the United States, Thailand, Singapore, Indonesia and Japan, with several other nations participating in various portions of the event.



A U.S. Marine fires the FN-303 Less-Lethal Launcher during an NLW familiarization firing at COBRA GOLD 2009.

JNLWD photo by Larry Brown

U.S. Pacific Command (PACOM) Non-Lethal Weapons (NLW) Combatant Command Liaison Officer (CLO) Larry Brown provided NLW training support for CG09. Brown presented the NLW overview brief and part of the NLW munitions brief to some of the exercise participants. Gunnery Sgt. Eric Meek, a military policeman and NLW instructor with the 1st Marine Aircraft Wing stationed in Okinawa, Japan, presented the remainder of the NLW munitions brief. Following the briefs, Meek led an NLW familiarization firing using the FN-303 Less-Lethal Launcher, a compressed-air-powered launcher that can fire non-lethal munitions, and the TASER[®] human electro-muscular incapacitation device.

U.S. Marines stationed in Okinawa were among those receiving the NLW training. According to Brown, the U.S. Marines appreciated the NLW education and familiarization they received at the exercise. "The Marines said it was well worth the time and added to their overall training," Brown said.

Captain Blaise McFadden, an operations officer with the Combat Logistics Battalion 31, 31st Marine Expeditionary Unit, agreed. His unit sent Marines to participate in the training exercise.

"The Marines came back raving about the non-lethal weapons component," Capt. McFadden said. "We are very interested in participating in non-lethal weapons training and education opportunities in the future."

NLW static exhibits were also on display, giving greater visibility to NLWs, especially to participants unable to attend the NLW training during the exercise. In addition to military training exercises, CG09 also included humanitarian and civic assistance projects.

PACOM and the Royal Thai Armed Forces co-sponsored the event. U.S. soldiers, sailors, airmen and Marines from around the world participated in and led many events throughout the exercise.

CG09 marks the 28th anniversary of the training exercise. COBRA GOLD 2010 is tentatively scheduled for next February. The JNLWP plans to continue to support training efforts for the exercise.

—BY JENNIFER BOWEN



PACOM CLO Larry Brown explains the capabilities of various currently fielded non-lethal weapons during COBRA GOLD 2009.

U.S. Army photo by Staff Sgt. Crista Yazzie



CLO in Action: Larry Brown at U.S. Pacific Command (PACOM)

The Non-Lethal Weapons (NLW) Combatant Command (COCOM) Liaison Officers (CLOs) are the Joint Non-Lethal Weapons Program's representatives in the field. CLOs work to raise awareness and visibility of NLWs in their respective COCOMs. They also help identify specific needs for NLWs in the COCOM and establish procedures for integrating NLWs into operational planning.



PACOM CLO Larry Brown
Official U.S. Marine Corps Photo

Q: How long have you been PACOM CLO?

A: Since July 2006.

Q: What is your hometown?

A: I was born and raised in Pitman, N.J.

Q: What is your area of responsibility (AoR)?

A: My AoR is PACOM, which includes 36 countries ranging from India, China and Mongolia down to Australia and New Zealand. It economically ranges from countries like Cambodia and Vietnam to Japan, Korea, China and Australia.

Q: What role do non-lethal weapons play in PACOM?

A: Non-lethal weapons are becoming a bigger part of the training exercises in PACOM (see *COBRA GOLD 2009, page 3*). During COBRA GOLD 2007, we conducted a small familiarization firing with a U.S. and Thai Marine company, a small demo for the Thai Special Forces, and the opening and closing ceremonies for the exercise. Now we've been requested to additionally do familiarization firings in the Philippines and Australia.

Q: What was your most recent travel as CLO?

A: In early March, I was in Australia conducting the Initial Planning Conference for the Non-Lethal Weapons Executive Seminar (NOLES), an annual military exercise and training event held in a different country each year. I am typically on travel for about half the time from January through July and about a quarter of the time from August to December.

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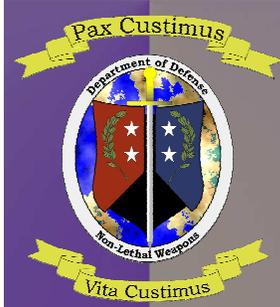
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Research Advances Millimeter-Wave Source for Active Denial Technology

Years of research and development have proven that the Active Denial System (ADS), a developmental directed-energy, counter-personnel weapon, can safely deter individuals at extended ranges. The ADS uses Active Denial Technology (ADT) to project a focused beam of 95GHz millimeter waves to induce an intolerable heating sensation on an adversary's skin, repelling the individual with minimal risk of injury. While the effects of the ADS have been successfully established, the technology that produces those effects has the potential to progress in a number of ways.

As Active Denial Technology continues to advance, one key research effort is focusing on making the ADS smaller and lighter. An essential component to this effort centers on the system's millimeter-wave source. To reduce the size, weight and cost of the system, researchers are developing a solid-state source to replace the current tube-based design. The current system uses large vacuum tubes and a gyrotron to project the 95GHz millimeter waves with enough power to cause the desired repel effect. The idea behind the solid-state source is to instead use small chips to generate the same millimeter waves, greatly reducing the system's size, weight and cost.

"Active Denial Technology has the potential to provide a tremendous new capability to our warfighters," said Colonel Kirk Hymes, Director of the Joint Non-Lethal Weapons Directorate (JNLWD). "We already know that ADT can safely repel individuals. Now we need to incorporate the technology into a system that our troops can use on a mobile platform to meet the needs of modern missions."

Funded by the Joint Non-Lethal Weapons Program (JNLWP), the effort reached a noteworthy milestone this winter when researchers successfully demonstrated solid-state technology. They delivered lower-power 95GHz millimeter waves with the solid-state source. To build on this success, researchers are now focusing on using the solid-state technology to generate higher power. Over the next several years, efforts will focus on gradually increasing the power output, with the goal of matching that of the current Active Denial System.

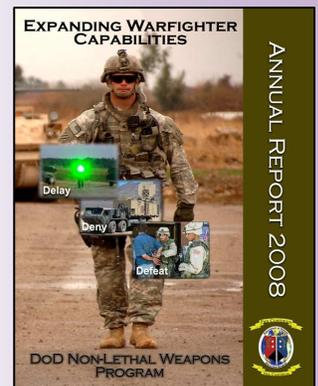
According to Rick Scott, project engineer at the JNLWD, advances in solid-state technology have the potential to enable important developments in ADT. These include the ability to use ADT for mobile operations in urban terrain, quicker system activation, reduced standby power requirements and improved system reliability in typical field operating environments.

As Active Denial Technology advances, the JNLWP will continue to work toward fostering this promising non-lethal capability and providing warfighters with additional escalation-of-force options.

—BY NANCY KOREEN

2008 JNLWP Annual Report Focuses on Milestones

The Department of Defense Non-Lethal Weapons Program Annual Report 2008 is available online on the Joint Non-Lethal Weapons Program website. The 26-page report features the year's highlights and milestones in non-lethal weapons from around the globe. The report is widely distributed and serves as a basic reference document for those interested in the DoD's Non-Lethal Weapons Program. To download the 2008 Annual Report, visit https://www.jnlwp.com/public_affairs/annual_report.asp.





New Zealand Army Officers Learn More about Non-Lethal Capabilities in the Escalation of Force



Douglas Jerothe (left), Deputy Director of the JNLWD, discusses non-lethal capabilities with Col. Phil Collett of the New Zealand Defence Force.

JNLWD photo by Wanda Napier

Officers from the New Zealand Defence Force paid a visit to the Joint Non-Lethal Weapons Directorate (JNLWD) in Quantico, Va., on April 6 to learn more about non-lethal weapons (NLW) capabilities. The officers wanted to draw on the experiences of the U.S. military to learn more about how they can incorporate escalation-of-force tools into the New Zealand Army's arsenal.

New Zealand Defence Force officers Colonel Phil Collett, Lieutenant Colonel Peter Kelly and Major J.P. Kaio visited the JNLWD to learn about best practices, upcoming technologies and training methods for NLWs. Col. Collett, Assistant Chief of General Staff for Capability, explained that the New Zealand Army is working to expand its use of non-lethal weapons.

"We've identified the need for a less-lethal force option," said Col. Collett. "You've got to give your forces the ability to escalate—to give options between shouting and shooting. You've got to have the ability to deal with belligerent individuals in situations where the rules of engagement don't allow the use of lethal force."

During the visit, Douglas Jerothe, Deputy Director of the JNLWD, told the officers about upcoming directed-energy technologies the Joint Non-Lethal Weapons Program is researching, including vehicle- and vessel-stopping efforts, as well as new counter-personnel technologies. Jerothe also offered information on some of the challenges the U.S. military is facing in fielding NLWs. He explained that the military and the public need to understand that NLWs provide an additional option but do not replace lethal force.

"Use of non-lethal weapons first is situationally dependant," said Jerothe. "Use of non-lethal capabilities does not prevent warfighters from using lethal means when required."

The New Zealand visitors expressed great interest in expanding their Army's non-lethal capabilities and appreciated the opportunity to learn from the U.S. military's experiences. They also provided the JNLWD information about their experiences with and requirements for NLWs. The visit helped foster a growing rapport between the two countries and will help expand non-lethal capabilities throughout the United States' international allies.

—BY NANCY KOREEN



People & Places

Naval Surface Warfare Center Dahlgren Division and the Directed Energy Warfare Office

In 1918, the U.S. Navy founded the U.S. Naval Proving Ground in Dahlgren, Va., now called the Naval Support Facility (NSF) Dahlgren. Located along the lower Potomac River, Dahlgren offers an excellent location for naval testing. The Naval Surface Warfare Center Dahlgren Division (NSWCDD) is the largest of a half dozen major commands that currently reside on NSF Dahlgren and represents one of Naval Sea System Command's largest research and development centers. NSWCDD is also home to the Directed Energy Warfare Office (DEWO), which conducts directed-energy vehicle- and vessel-stopping research on behalf of the Joint Non-Lethal Weapons Program (JNLWP). The JNLWP-sponsored fiscal year 2009 efforts for NSWCDD total approximately \$10 million.

DEWO currently manages a number of non-lethal directed-energy vehicle- and vessel-stopping research efforts. These include radio-frequency vehicle- and vessel-stopping projects, which study the use of radio-frequency directed energy to temporarily disable engine electronics; the pre-emplaced electric injection effort, which focuses on injecting electric currents into the undercarriage of vehicles to disable them; the laser windshield obscuration project, which is addressing the laser parameters necessary to safely obscure a vehicle windshield; and the Distributed Sound and Light Array project, which is developing a non-lethal acoustic and optical weapon that provides hailing and warning capabilities.

The research conducted at Dahlgren for the JNLWP has the potential to provide important non-lethal capabilities for warfighters. Dr. Frank Peterkin, Head of Programs at DEWO, notes that the U.S. military's recent experiences in theater have brought to the forefront the need for new directed-energy technologies. "When we have situations with civilians, most of the time they mean no harm," said Dr. Peterkin. "If we can find ways to stop a vehicle or vessel at extended ranges, we can save lives and prevent unfortunate situations."

According to Dr. Peterkin, his organization manages the largest directed-energy research effort in the Navy. "We've had literally decades of work at this warfare center related to directed energy," he said. As part of a warfare center, DEWO gets its work from sponsors, which Dr. Peterkin says keeps the organization competitive and sharp. "We have a lot of unique facilities, people and equipment," he said.

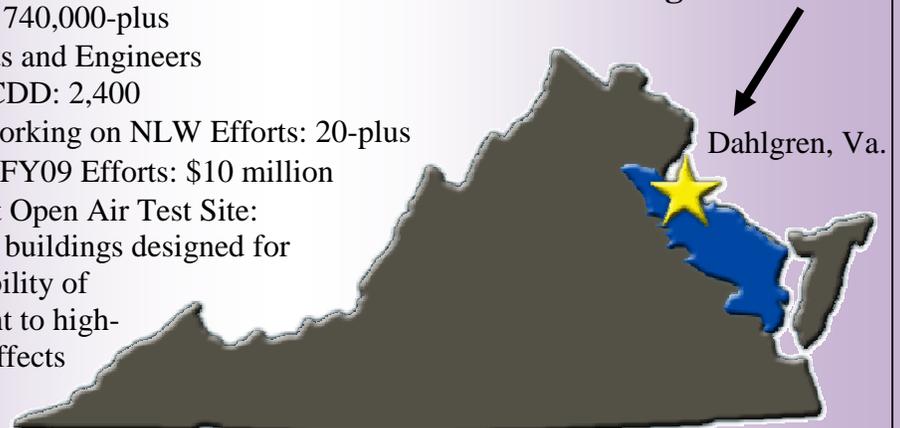
With a host of scientists and engineers, as well as facilities designed for studying directed energy, the Directed Energy Warfare Office is making important contributions to the JNLWP's technology research efforts.

—BY NANCY KOREEN

Quick Facts:

- Congressional District: 1st
- District Population: 740,000-plus
- Number of Scientists and Engineers Employed at NSWCDD: 2,400
- Total Employees Working on NLW Efforts: 20-plus
- JNLWP-Sponsored FY09 Efforts: \$10 million
- Dahlgren's Maginot Open Air Test Site: Two concrete block buildings designed for testing the susceptibility of electronic equipment to high-power microwave effects

Naval Surface Warfare Center Dahlgren Division





Non-Lethal Effects and Crowd Behavior Program Wins Award

U.S. Joint Forces Command (JFCOM) recently developed a computer modeling and simulation program to study crowd behavior. In February, the Non-Lethal Effects and Crowd Behavior Modeling and Simulation Test Bed project received the 2009 National Training and Simulation Association (NTSA) Award for Outstanding Achievement in Modeling and Simulation in the Analysis category. The Networked Urban Operations Test Bed (NUOTB) working group developed the test bed.



This Non-Lethal Effects and Crowd Behavior Modeling and Simulation Test Bed-generated image features the Active Denial System in use for an urban operations crowd control scenario.

Official JFCOM Image

The working group created a virtual test bed, made up of a series of computer-generated model and simulation programs. The group designed the test bed to simulate and analyze non-lethal effects on the behavior of a crowd that is not necessarily a hostile or lethal threat to a joint military force operating in an urban environment.

The test bed can analyze individuals by their emotional state, location, speed at which they are moving, direction of movement and numerous other factors. The program can also display overall trends of the virtual crowd for analysis. Compared to earlier crowd behavior test beds, this latest test bed allows for a variety of crowd reactions to occur in an unscripted way, according to Gordon Todd, JNLWP Non-Lethal Weapons (NLW) Combatant Command Liaison Officer to JFCOM and working group member.

Todd said the working group hopes the test bed will help the military develop tactics, techniques and procedures based on possible crowd behavior.



(Left to right) Congressman J. Randy Forbes (VA-04), NUOTB technical lead Tina Gaumond, Congressman Robert Wittman (VA-01), NUOTB principal investigator Steve Hansen and retired Rear Admiral Fred Lewis, NTSA president, with the 2009 NTSA Award for Outstanding Achievement in Modeling and Simulation in the Analysis category.

Official JFCOM Photo

Lieutenant Colonel Craig Price, an action officer with the U.S. Marine Corps assigned to JFCOM J9-Joint Concept Development and Experimentation, provided the working group with recommendations for the tactics and situations to include in the test bed to create realistic scenarios. Lt. Col. Price, who has experience with military crowd control operations in Somalia and Iraq, said he believes the test bed has potential applications for experimentation and in the

(continued on page 9)

Non-Lethal Effects and Crowd Behavior Program Wins Award *(continued from page 8)*

development and analysis of tactics, techniques and procedures for dealing with crowds in urban environments.

“Effective crowd control is key to the Joint Force’s ability to conduct humanitarian assistance operations, foreign internal defense missions and host nation support,” said Lt. Col. Price.

According to Todd, the test bed’s realistic simulations allow users to more accurately evaluate non-lethal capabilities. “While non-lethal capabilities are being developed, it is unrealistic to expect to be able to test their effectiveness and the tactics, techniques and procedures for their use against human subjects,” said Todd. “The test bed provides a critical modeling and simulation testing venue.”

The NUOTB working group created the test bed through a Cooperative Research and Development Agreement between the JFCOM Joint Irregular Warfare Center (JIWC) (previously the Urban Operations Office) and a defense contractor. More than 70 people from about 25 organizations participated in the development of the test bed, including representatives from the Joint Non-Lethal Weapons Program.

The NTSA presented the award to NUOTB working group representatives at a formal ceremony during NTSA’s Modeling and Simulation Leadership Summit on February 2 in Norfolk, Va.

—BY JENNIFER BOWEN

Improved Flash-Bang Grenade Team Wins Best Scientist Team Award

The U.S. Air Force team researching the human effects characterization of the Improved Flash-Bang Grenade (IFBG) recently won the Air Force Materiel Command (AFMC) 2009 Science, Engineering and Technical Management Award in the Scientist Team category. AFMC chose the IFBG team for its efforts that led to the development of a safer and more effective flash-bang grenade.

The IFBG creates a loud bang and a large, bright, long-duration flash to temporarily incapacitate targeted individuals. The Joint Non-Lethal Weapons Program sponsors the IFBG program.

The 12-member team determined the human effects necessary to increase mission effectiveness by analyzing flash-bang grenade injury data, writing software to analyze flash effects and determining sound exposure limits.



IFBG team members (left to right) 2nd Lt. Dave Wooddell, mathematician; 2nd Lt. Katharine Sheldon, human effects lead; 2nd Lt. Allan Nagy, computer engineer; and Dr. Robert Thomas, principal research physicist, accept the AFMC award during a May 6 ceremony at Wright-Patterson Air Force Base in Dayton, Ohio.

U.S. Air Force photo by Ben Strasser

(continued on page 10)



IFBG Team Wins Best Scientist Team Award *(continued from page 9)*

The annual AFMC awards recognize science, engineering and technical management excellence and achievement throughout AFMC. A record 143 nominees competed for 25 awards this year, according to Dominick J. Tuccillo, resources division chief at AFMC's Directorate of Engineering and Technical Management.

The IFBG team will now go on to compete in the Scientist Team category with other teams throughout the entire U.S. Air Force.

During a ceremony at Wright-Patterson Air Force Base in Dayton, Ohio, on May 6, AFMC presented the award to four IFBG team members on behalf of the entire team.

The AFMC honor came on the heels of another award the IFBG team recently won. In January, the team received the Air Force Research Laboratory's top technology transition award for 2008.

—BY JENNIFER BOWEN

War Game Evaluates Non-Lethal Capabilities

As the U.S. Army considers increasing its non-lethal capabilities, the Service is leading efforts to assess non-lethal weapons (NLW) effectiveness and requirements. As part of these efforts, the Army conducted a Future Combat Systems (FCS) Non-Lethal War Game at Fort Leonard Wood, Mo., April 7-9. A war game is a military simulation in which military personnel can explore and assess theories of warfare without engaging in actual hostilities.

The war game evaluated currently fielded non-lethal weapons, devices and munitions. As part of the evaluation, the Army sought to answer two questions with the war game: given two identical units in the same situations, one unit with non-lethal capabilities and the other unit without—

1. Which unit is more effective and successful at accomplishing the mission?
2. What are the most effective capabilities, and what are the best ways to employ them?

While the war game mainly focused on the FCS-enabled Brigade Combat Team (BCT), the exercise was part of the Army's larger effort to determine the required non-lethal capabilities for all Army BCTs. The U.S. Army Capabilities Integration Center (ARCIC) and the U.S. Marine Corps Combat Development Command will use results from the war game to provide various organizations across the Services data on the required types and amounts of non-lethal capabilities.

According to Major Jeff Winegar, U.S. Army NLW Central Action Officer and war game coordinator, current modeling and simulation efforts will incorporate the data gathered during the exercise.

"The goal is to eventually develop a simulation and training tool and a command and control planning tool for non-lethal capabilities," Maj. Winegar said. "These tools will be used to integrate non-lethal capabilities into the overall operational environment and operational effects."

The Maneuver Support Battle Laboratory, the U.S. Army Non-lethal Scalable Effects Center and the U.S. Army Maneuver Support Center conducted the war game at the direction of ARCIC. The official war game report is pending and should be available by September 2009.



Maj. Jeff Winegar,
U.S. Army NLW
Central Action Officer

*JNLWD photo by
Wanda Napier*

—BY JENNIFER BOWEN



Hail & Farewell

Hail to:

BGen Mark Clark, USMC
Joint Integrated Product Team
U.S. Special Operations Command
Voting Principal

Col Tracy Tafolla, USMC
Director
Joint Non-Lethal Weapons Directorate

LtCol Jay Livingston, USAF
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Voting Principal

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Joint Non-Lethal Weapons Directorate

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Concepts Officer
Joint Non-Lethal Weapons Directorate

Capt Seth Crawford, USMC
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Bill Webber
Active Denial System Project Coordinator/
Military Analyst
Joint Non-Lethal Weapons Directorate

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Joint Integrated Product Team
U.S. Special Operations Command
Voting Principal

Col Kirk Hymes, USMC
Director
Joint Non-Lethal Weapons Directorate

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Peggy Smith
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