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Contents

Directed Energy Weapons and the Asymmetric Fight 1

Director's Corner 2

In the News 7

WSTIAC Success Story: Longbow Apache Block III 9

TEMS Update 9

WSTIAC Courses:
Directed Energy 10
Sensors/Seekers 11
Smart/Precision Weapons 12
Weaponeering 13

Calendar of Events 14

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WSTIAC
Weapon Systems Technology Information Analysis Center

Directed Energy Weapons and the Asymmetric Fight

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INTRODUCTION: THE CHALLENGE OF ASYMMETRIC WARFARE

Recent military engagements have made it apparent that US forces need new weapon systems that can provide an alternative response to the asymmetric warfare that they face while under the continuous scrutiny of a global media environment. There are many challenges facing the US military, government agencies, and law enforcement which include an increasing spectrum of missions as the world situation changes. The US military is currently involved in two major operations in the Middle East, peace-keeping missions in Europe, support of national allies, and protection of US interests around the world. The US Army reports that it has deployed 251,000 soldiers in 120 countries as of 21 November 2006 [1]. None of these deployments are traditional state-versus-state warfare operations. The majority of current engagements involving hostilities include:

- Non-state agencies attacking an established government for political objectives
- Non-state agencies attacking an established government for criminal activities
- Non-state agencies attacking a local population for religious reasons

These situations illustrate what has come to be known as asymmetric warfare. Other terms that are used to describe this type of action are insurgency, civil disturbance, and civil war. Asymmetric warfare has been defined as "leveraging inferior tactical or operational strength against the vulnerabilities of a superior opponent to achieve disproportionate effect with the aim of undermining the opponent's will…"[2] In simple terms, an adversary will avoid engaging US military strengths. In asymmetric warfare, adversaries use a number of different tactics and techniques to achieve their objectives. These include terrorism, guerilla warfare, information and public relations campaigns, and other forms of violence. These tactics center on the strategy of avoiding direct tactical engagement against superior military forces. Examples of such tactics include using human shields to prevent return fire, taking cover and hiding in buildings with cultural significance, intermingling with the indigenous population, and concealing their own identities. Tactics of unrestrained violence often involve striking at noncombatant populations and nonmilitary facilities in order to force the superior military to constantly react to a changing threat.

These asymmetric warfare tactics present a major challenge for United States organizations which are structured, equipped, and trained for traditional force-on-force engagements. US military units operate with standard equipment, which ranges from individual and crew served weapons to airborne weapons, direct fire weapons, anti-armor weapons, and indirect fire weapons [3]. The current weapons used are classified as conventional munitions systems. Conventional munitions rely upon explosive force for lethal and less-than-lethal functions. As a result, these weapons may cause collateral damage and unintended injury to noncombatants, and may also leave behind unexploded ordnance and other explosive remnants of war [4]. These weapons are appropriate and necessary when lethal force is required for the mission at hand. However, they can be very detrimental to the mission in stability operations where public opinion is critical for mission success.

continued on page 3

Director's Corner

Welcome to the winter edition of our newsletter. The feature article is by Mr. Chuck Park, Vice President for Directed Energy Applications at Gleason Research Associates. In his article, Mr. Park discusses directed energy applications and makes a suggestion to field a specific capability, the Active Denial System (ADS), which can make a difference *now*. Contributing to this issue is my Chief Scientist, Dr. Ed Scannell who is a directed energy weapons expert.

Directed energy systems provide the capability to destroy, defeat or deter the enemy using radiated waves or beams of microscopic particles. I'll leave the technical details to the article but what really got my attention – literally and figuratively – is the capability to deter the enemy without permanent damage to the individual or the infrastructure. The Active Denial System generates a temporary sensation that is unbearable to even the strongest willed and pain tolerant individuals. I know because I experienced the sensation at the Space and Missile Defense Conference and Exhibition in Huntsville, Alabama, this past summer. I could not stand the sensation for even a second. It feels like a severe stinging or burning sensation that you just want to get away from. As Mr. Park will describe in his article, it is not just me. The Air Force conducted more than 10,000 tests (exposures) over the course of a decade. What they found was: 1) even the strongest physical and mental candidates could not withstand the sensation and 2) the effects are temporary, i.e., nonlethal, and meet current laws, federal regulations and procedures for testing. Another benefit of the ADS and most other directed energy systems is that it causes no infrastructure (buildings, electrical, phone, etc.) damage, so the tools are still there for noncombatants to continue to live productive lives.

I'm going to ask and provide my answers for the five basic questions regarding the ADS System: who, what, where, when and how.

Who could use the capability?

- US and friendly military and police units.

What can you do with this capability?

- Deter a threat by clearing an area and provide a safe zone.
- Isolate the threat from the noncombatants. Provide advance notice that the capability will be used. The noncombatants will voluntarily clear the area leaving only the threat (if they can stand it) which then can be defeated by conventional means.
- Leave infrastructure in place so the noncombatants can live productive lives.

Where can we use this capability?

- Iraq, Afghanistan, and other urban threat operations that need safe zone protection.

When can we use this capability?

- We can use this capability immediately. However, steps must be taken to fully train, support and sustain fielded units.

How can we use this capability as quickly as possible?

- Promote capabilities to the User and Acquisition communities.
- Get agreement and approval on the need.
- Get agreement on a demonstration in an operational environment. (An Advanced Concept Technology Demonstration and other testing on a vehicle mounted design were completed in 2005 and 2006.)
- Develop, execute and maintain training for receiving and fielded units.
- Develop, execute and sustain support for receiving and fielded units.
- Attain accelerated acquisition approval through DoD as a Transformational Capability – possibly an Acquisition Challenge, Rapid Fielding, etc. program.
- We need to get it out there and see what it can do.

The above represents my views on a capability that has the potential to really make a difference in the near-term and well into the future. I'm sure there are aspects of fielding a near-term capability that are not totally flushed out that will need to be addressed. However, the one thing we owe our current and near-term future war fighters is to get this potential 'silver bullet' through the system and into the field as quickly as possible to see if it can:

- Save lives,
- Deter insurgents, and
- Win over the Americans, Iraqis, Afghanis, and other populace.

I, for one, think it's worth a try.

Please provide feedback on this important subject.

Sincerely,
Gary

Gary J. Gray
Director

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continued from page 1

Stability operations taking place among an indigenous population require minimal collateral damage to structures, thereby protecting and supporting the local economy. Such operations must avoid casualties to local civilians to maintain good standing among the indigenous population. Yet, the weapon systems must be effective in the urban environment to provide an overall sense of security among the population. The weapons that US forces are required to perform their duties with are not well-suited for these new battlefield environments and mission tactics. As a result there is a need for weapons that are ultra-precise and scaleable in their effects on targets in populated areas. There currently exists weapons technology that has the potential to fill the current capability gap.

Bridging the Capability Gap

Gaps in current capability will always exist when the threat, the political environment, and technology are endlessly changing. Military history is replete with examples of gaining a technology lead in one area only to lose that edge to an effective countermeasure. However, there are technologies that force a major shift in warfare. Weapons that provide significant changes in range, lethality, and speed of operations have changed warfare from static engagements to high-speed maneuver operations. Ballistic systems forced major changes in defensive operations from fortifications. The continuous evolution in conventional munitions led to total war in World War II with whole cities being reduced to rubble. Global information systems have changed world opinion on this level of devastation.

The world demands less random destruction and lethality in military operations. Thus, the challenge is to complete the mission of finding, fixing, engaging, and destroying the enemy without destroying the surrounding environment. Directed energy weapons (DEWs) provide a potential solution to the difficulties US forces face in their new battlefield environment.

Figure 1. An antenna atop a transportable shelter is the most visible portion of the Active Denial Technology test bed on Kirtland Air Force Base. This technology uses a millimeter wave beam of energy to create an intense heating sensation that repels people without causing permanent injury. (Photo Courtesy of US Air Force Research Laboratory's Directed Energy Directorate.) [7]

A PROPOSED NEAR TERM SOLUTION

The Active Denial System (ADS) is one example of a directed energy weapon (DEW) that can be effectively used for counter personnel and crowd control in the asymmetric warfare environment. Colonel David Karcher, Director of the Joint Nonlethal Weapons Directorate describes the real environment and a potential solution.

> "If, in the future, a group of civilians and enemy soldiers mass on a strategic bridge and refuse to leave, the military may use non-lethal means to confront the problem. This could be done using ADS [5]. With significant strategic implications, ADS could play an important role by slowly and deliberately sweeping the unruly crowd off and away from the bridge, thus allowing forces to traverse the bridge and avoid a dangerous backlash that would likely have resulted from using deadly force, or the threats of such force, to otherwise clear the bridge."[6]

This is a perfect example of how directed energy can be used to shape the engagement, control access, and deny adversaries movements in an engagement—since all of this is accomplished in a nonlethal manner, the ADS (Figure 1) is a DEW that is also considered to be a nonlethal weapon (NLW).

Three examples of where the Active Denial System could have near-term impacts are:

- Crowded streets in an urban environment with noncombatant population.
- Critical infrastructure protection including nonmilitary facilities.
- Sniper / ambush response in open terrain, mountain terrain, and urban areas.

The crowded street scenario is encountered every day in current operations around the globe. Being visible and present in the daily environment creates a sense of security and supports stability operation objectives for building rapport with the local population. Adversaries have used this situation to attack US forces or the local population to intimidate and destroy that sense of security. Conventional munitions and kinetic-based nonlethal systems drive everyone from the scene which destroys any sense of security.

Insurgents have attacked non-military targets around the globe to achieve their objectives. A fixed Active Denial System can be deployed with integrated sensors to provide protection. Remote automated controls have been developed, tested, and demonstrated that the system can be controlled without exposing operators.

Countering snipers has challenged military and law enforcement agencies for many years, with preventing the first shot being the toughest challenge. The second toughest challenge is preventing a second shot. Both challenges require a holistic, or systems, approach that includes topography analysis, preemptive patrols, electronic surveillance, and constant vigilance to reduce casualties. However, the advantage remains with any well-trained sniper. The Active Denial System could be deployed with an integrated sensor suite to provide the earliest possible detection. Automated cueing from infrared, optical, or acoustic sensors could be integrated with steering controls to provide an accurate aiming system. Automated systems control with man-in-the-loop overrides would initiate a short engagement cycle to force the sniper to move. The beam bounces inside of enclosures (rooms, "hides", etc.) to force a sniper to move. This nonlethal response increases the opportunity for positive identification and engagement with more lethal means.

ADS STATUS

The Active Denial System is a counter-personnel nonlethal, directed energy weapon.[8] This program began in 1989 with a capability need statement. A stationary "Base 0" system was funded in 1997 to develop the technology. An Advanced Concept Technology Demonstration (ACTD) took the system to a vehicle mounted system (Figure 2). Subsequent testing and application of lessons

learned has prepared the system to go through three Military Utility Assessments from 2005 to 2006. The system fills the gap for "…a long range rapid repel and deterrent capability".[8]

The ADS system generates a 95 gigahertz millimeter wave. A trained operator controls the systems antenna through a software controlled interface. An integrated bore-sight suite gives the operator clear view of the entire beam path and target area. Safety enhancements in the software controls the duration of the beam to generate a safe and effective nonlethal repel. The target feels an intolerable heat sensation, but the effect is temporary and ends when the target leaves the beam or the beam is terminated. The sensation stimulates an aversion response in the target which adds a self-limiting exposure limit by the target. The US Air Force has conducted over a decade of testing and evaluation of human effects data. More than 10,000 exposures have been documented to ensure the system meets all laws, federal regulations, and procedures for testing.

Figure 2. Vehicle Mounted Active Denial System. The sensation causes targeted individuals to repel or retreat. (Photo Courtesy of US Air Force Research Laboratory's Directed Energy Directorate.) [7]

Benefits of Directed Energy

The ability of DEW systems to interact with their targets in a new and unique way is also what makes them transformational weapons. At low power levels, DE has the potential of also providing extremely accurate targeting, passive and reflective sensing and target identification, high data-rate communications, and especially nonlethal target effects on both target electronics and personnel; i.e., just enough energy on target to cause a mission failure (sometimes termed a "soft kill" as opposed to a destructive mode "hard", or "kinetic" kill). At high enough powers, DEWs can, however, provide enough energy on target to "burn-through" the skins of aircraft and missiles, providing the "kinetic energy" (KE) type kills of conventional ordnance.

Directed energy systems convert electrical or chemical energy into a beam or pulse effect that can be regulated by the operator. Because they are based on radiated energy, the operator potentially can vary the beam to achieve specific results. The operator manipulates the intensity, duration, and wavelength, and thereby, the focus of the beam. This control could provide the operator very precise control over any engagement. Automated controls enable the systems to precisely manage the output in time critical engagement events.

DEW Characteristics

Directed energy systems have seven (7) unique characteristics that make them attractive in tactical operations.[9]

1. Speed of light engagements at 300,000 km per second

Directed Energy: the Promise and the Reality

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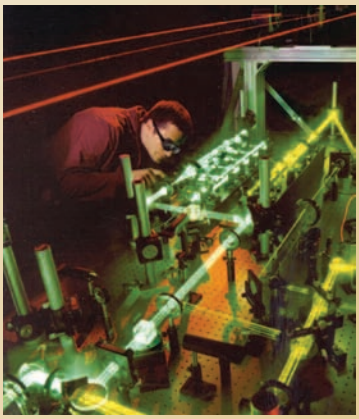

Figure 1. A technician evaluates the interaction of multiple lasers that will be used aboard the Airborne Laser, a megawatt-class laser weapon system being developed to defend against ballistic missile attacks. The Directed Energy Directorate conducts research into beam-control technologies. (Photo Courtesy of US Air Force Research Laboratory's Directed Energy Directorate.) [4]

Any discussion of directed energy must recognize the difference between long-term potential and short-term reality. There is no doubt that existing long-term development programs will provide significant military capability in the future. However, directed energy has also demonstrated its maturity and readiness for current operations in three different mission tasks from the Army Universal Task List [1], the Army Force Operating Capabilities, or the Joint Universal Task List documents. These include demonstrated abilities to engage and destroy rockets, artillery, mortars, unexploded ordnance, minefields, and explosive remnants of war; and perform unit level force protection tasks.

Defining Directed Energy

Directed Energy Weapons are typically defined as devices that destroy/defeat targets using radiated waves or beams of microscopic particles. With this definition, future DEWs may include systems that are based on other principles in addition to electromagnetic energy, such as acoustic waves and fluid/particle systems.[2] Present DEWs are only based on electromagnetic energy principles and include Laser, Charged Particle Beam (CPB) and Radio Frequency (RF)/High Power Microwave (HPM) systems, each of which projects energy that travels at (or near in the case of CPBs) the speed of light toward the target. Because of the physical nature of their radiation source, lasers are a point weapon, while RF/HPM sources have "radar-like" antenna patterns, and are therefore considered an area weapon.

Electromagnetic DEW systems span the electromagnetic spectrum. Energy systems are classified by frequency and/or wavelength. This includes gamma rays, x-rays, ultraviolet, the visible spectrum, infrared, terahertz radiation, microwave, and radio waves. Directed energy systems currently include lasers (Figure 1), high powered microwave, high power millimeter wave, dazzling visible lights, and pulse energy systems.[3]

Categorization of DEWs

The DoD's HPM program includes wideband RF, and a HPM sub-group addresses all of RF-DEW. In general, high energy laser (HEL) DEWs lie in the infrared through visible light frequency bands, while high power microwave (HPM) weapons lie in the lower frequency microwave bands (i.e., between 800 MHz to 3 GHz), which are shown in Figure 1. With the nomogram provided in Figure 2, frequency values can be converted to wavelengths. It should also be pointed out that a common misnomer is to

2. Simplified engagement calculations without having to consider gravitational pull or aerodynamic drag
3. Ultra-precise targeting at extreme ranges (especially for laser weapons)
4. Scaleable effects
5. Low per-shot cost
6. Deep magazine
7. Dual use as sensors

These systems also have negative characteristics that must be considered as well. These include sensitivities to conductive material for radio frequency transmissions; and atmospheric dissipation with dust, moisture, and turbulence (especially with lasers—but manageable with recent advances). Finally, control and beam focus on the highest frequency beams is difficult. The combination of positive and negative characteristics allows directed energy to complement conventional munitions systems in the full spectrum of military missions.

Two other examples demonstrate how these energy systems have been developed, tested, analyzed, and in some cases applied in specific mission areas. These include countering rockets, artillery, and mortars (C-RAM); and clearing unexploded ordnance (UXO) in a battlefield environment.

Counter Rocket Artillery and Mortar (C-RAM)

One example of the Rocket Artillery and Mortar threat is the 2006 conflict between Hezbollah and Israeli Defense Forces. Hezbollah, a non-state agent, fired 4,228 rockets into Israel in a 30 day period.[10] The Middle East Intelligence Bulletin estimated the Hezbollah rocket arsenal at "up to 10,000 short and long-range rockets".[11] The inexpensive, easy–to-make short-range ballistic rocket has become one of the asymmetric warfare cornerstones. The rocket meets all of the requirements for asymmetric warfare. It can be fired from simple rail structures. Its primary purpose is to create panic in the noncombatant population. The attacks forced 250,000 civilians to evacuate the region. Most economic activity in northern Israel was suspended for a month.[12] The Tactical High Energy Laser (THEL) has demonstrated that a directed energy system can complete the entire targeting and engagement kill-chain within the limited flight time of these devices. (Another example was just demonstrated against 60mm mortars by a Raytheon-Government team with their solid-state Laser Area Defense System (LADS).[13]) This is just one example of how a laser system can be used for defending friendly forces and critical facilities. Continued experimentation of lasers in defensive and offensive roles concurrent with the development of new laser systems and components will accelerate the Department of Defense effort to fill this existing capability gap.

Unexploded Ordnance (UXO) and Explosive Remnants of War

The Laser Ordnance Neutralization System (LONS) is another laser system that has demonstrated its operational capability in the tactical environment. This system, called Zeus, has demonstrated the ability to accurately use laser energy on unexploded ordnance (UXO) to destroy the ordnance with standoff ranges. The Zeus

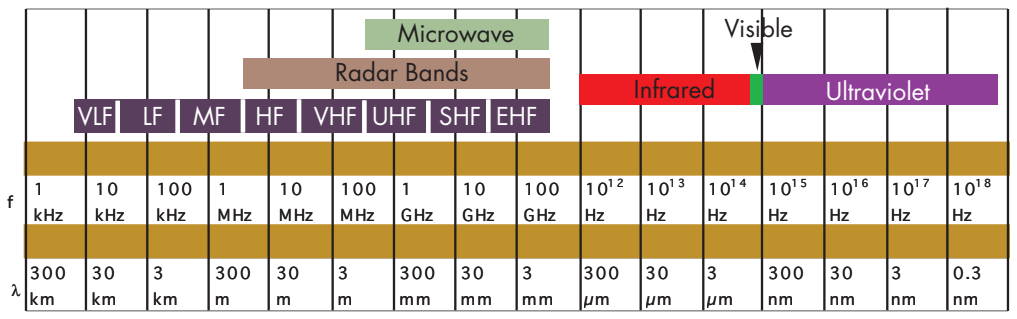

Figure 2. Electromagnetic Spectrum and Frequency-Wavelength Nomogram.

label HPM as "EMP," since the latter refers specifically to the electromagnetic pulse (EMP) generated by a nuclear detonation, which is in the very low microwave band, normally between 100 and 200 MHz.

Evolution of Weapons Technology

Directed Energy Weapons represent the natural next step in the "speed-of-light engagement" process, addressing the slowest part of the detect-to-kill cycle; that is, actually delivering sufficient energy to a target to kill or disable it. This delay is due to the present dependency of military platforms and weapon systems on the speeds of jet engines, rocket propulsion or detonation/deflagration of gunpowder and ballistic ordnance velocities. DEWs, however, will enable the user to place energy on a target at the speed of light, thereby matching the "engagement" speed of the other parts of the "detect-to-kill" chain.

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focuses laser energy on the casing of the UXO causing it to be destroyed by internal combustion. The resulting low-order detonation combines with the standoff range to provide safety for ordnance personnel. The system uses diesel fuel for the laser and has no extraordinary chemical requirements. This system demonstrates that lasers are maturing quickly. Microwave sources also hold the promise to act as a "superjammer" that could potentially initiate or neutralize fuzes and firing sets.

These scenarios represent threats that will be encountered by agencies ranging from the military to emergency relief personnel. It is reasonable to assume that adversaries will continue to attack US interests around the globe. Directed energy offers new solutions to meet increasing threats.

A DEMONSTRATED CAPABILITY FOR THE CURRENT WAR FIGHTER

Directed Energy weapons hold the promise to be a transformational capability. Directed energy systems will expand current organizational capabilities for precision engagements, scaleable effects, and engaging time sensitive targets. The question is not if there will be directed energy weapons, but rather when will the weapons arrive on the battlefield.

Integrating transformational capability into the existing infrastructure is difficult and will require bold, transformational steps in the requirements and acquisition community to insert these capabilities into the future force.

Due to fundamental physical problems, some of the most desirable features of DEWs will remain in the future, such as completely "tunable" frequency DEW sources. However, through the tunability of other source parameters, such as power, pulselength, and repetition rate, these weapons can deliver scalable effects to a target—which is one the most desired capabilities, and one that enables their use for nonlethal effects, especially in counter-personnel applications, like the ADS.

The Active Denial System demonstrated a mature capability through an Advanced Concept Technology Demonstrator and multiple successful military utility experiments. The ADS supports maneuver, force protection, force application capability objectives and the operating capability requirements have been documented for current operations. The Active Denial System provides operational capability in the expanded missions that can not be satisfied with conventional weapons.

We owe our current and near-term future war fighters our best efforts to get this potential 'silver bullet' through the system and into the field as quickly as possible.

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in the news...

ARMY FIELDS ITS FIRST LIGHT-WEIGHT HOWITZER

by Edward Murray and Martin Kane
The Picatinny Voice

With the recent delivery of eighteen new M777 lightweight 155mm howitzers to the Army's 2nd Battalion, 11th Field Artillery at Schofield Barracks, Hawaii, the King of Battle, as the field artillery is often called, took a giant step forward.

Soldiers take the M777 through its first Army fielding during a live-fire battalion exercise at Pohakuloa Training Area in Hawaii.

The M777 is the military's newest field artillery weapon, a lightweight 155mm towed howitzer developed jointly by the Army and Marine Corps.

The program is managed by a joint-service program office. These weapon systems are manufactured by BAE Systems with final integration and assembly occurring at the firm's Hattiesburg, Mississippi, facility.

The M777 will replace all the Marine Corps' current M-198 towed howitzers and will be the artillery system for the Army's Stryker Brigade Combat Teams. It is the first ground-combat system to make extensive use of titanium in its major structures to trim weight; the howitzer is 7,000 pounds lighter than the M198 weapon it replaces. "The weight reduction improves transportability and mobility without impacting range or accuracy," said Joint Program Manager James Shields. Shields said the system will be compatible with the entire family of 155mm ammunition including the Excalibur precision munitions when it eventually is fielded.

The first Army unit equipped, the 2nd Battalion, 11th Field Artillery or 2-11 FA, is part of the Army's fifth Stryker Brigade Combat Team. It recently completed new equipment training and a live-fire battalion exercise using the basic M777 system at Pohakuloa Training Area on the Big Island of Hawaii. Prior to receiving the M777, the 2-11 FA was exclusively a 105mm battalion that was equipped with the M119 howitzer. The M777 has the deployability advantages of lightweight system like the M119 but the firepower of a 155mm weapon like the larger M198. It also is transportable by the Marine Corps' MV-22 tiltrotor aircraft. Two systems can be transported on a C-130 at the same time.

The new howitzers have returned to Schofield Barracks where they will be retrofitted with a digital fire control system (DFCS) to become M777A1s. The DFCS will provide the howitzer with the capability to communicate, navigate and aim, an upgrade that will increase their accuracy and responsiveness. The DFCS, which is also known as towed artillery digitization, was developed and is being manufactured for BAE Systems by General Dynamics Armament and Technical Products of Burlington, Vermont.

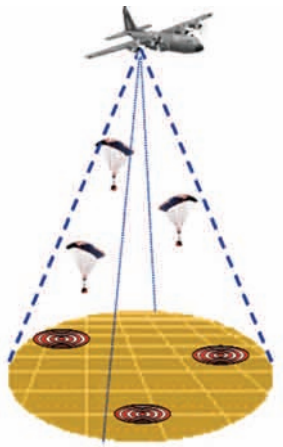
Soldiers from 2-11 FA said they were pleased with the new weapons and look forward to the added capabilities provided by the DFCS upgrade. The Marine Corps previously fielded the M777 to the 11th Marine Regiment and is continuing its fielding activities to other units. In addition, the Corps recently provided Canadian Forces in Afghanistan six M777s where the guns have been used extensively in combat with great success.

JPADS CONTINUES 'REVOLUTION IN AIRDROP TECHNOLOGY'

by Tech. Sgt. Scott T. Sturkol
Air Mobility Warfare Center Public Affairs

Since October 2005, the Air Mobility Warfare Center has partnered in an effort to revolutionize the way the Air Force does its airlift airdrops in the expeditionary environment and around the globe with the Joint Precision Air Drop System, or JPADS, initiative.

"When it was said to make this concept of JPADS a reality and we became Air Mobility Command's lead on this project, we started work right away," said Maj. Gen. David S. Gray, AMWC commander. "General (Duncan J.) McNabb (the AMC commander), made this a command priority and he definitely made it my No. 1 priority. I'm proud of how far we've come and how fast we got there."



This graphic illustration shows how a C-130 Hercules can airdrop supplies to multiple locations using the Joint Precision Air Drop System. The system uses global positioning system-guidance along with steerable parachutes to deliver air drop bundles into multiple landing zones. (US Air Force Graphic.)

In November 2005, AMC opened a JPADS "Tiger Team" that included representation from dozens of agencies at command headquarters, especially the Combat Operations Division and Plans and Programs, as well as people from the Air Mobility Battlelab and the Air Force Mobility Weapons School. The team was chaired by Col. Charles Stiles, the AMWC vice commander.

The team's work paid off when the first combat airdrop using JPADS took place over Afghanistan Aug. 31.

"That effort put us a day ahead of the goal for combat operability by Sept. 1," said Maj. Dan DeVoe, AMWC project officer for JPADS who deployed to Afghanistan in 2006 as part of the mobile training team establishing system operations in theater.

The system is a high-altitude, all-weather capable, global positioning system-guided, precision airdrop system that provides increased control upon release from the aircraft, said Major DeVoe.

"When you're able to complete airdrops at higher altitudes for example, it keeps the aircraft and aircrews safer and out of range

of the enemy," Major DeVoe said. "Additionally, with the ability to precisely drop bundles to multiple, small drop zones, JPADS brings an entirely new capability to the warfighter while saving lives and resources in the process."

Traditional airdrops by Air Force airlifters, such as the C-130 Hercules and C-17 Globemaster III, are at altitudes of anywhere between 400 and 1,000 feet. With JPADS, those same airlift aircraft have the potential to guide air drop bundles from as high as 25,000 feet.

JPADS includes a mission planner to plan the optimal release points using special software residing on a laptop computer. The computer is loaded with a high-resolution grid of forecasted winds. The mission planner also receives updated near real-time wind speeds while in the air using hand-launched dropsondes (hand-sized, parachute-equipped wind indicators).

There are also multiple types of JPADS parachute systems that either have one or two types of parachutes — steering and traditional, that is an airborne guidance unit equipped with a GPS receiver that has steering lines attached to the steering parachute and a GPS retransmit kit mounted inside the bundle to ensure uninterrupted signal reception. "When dropped, GPS receivers use the steering mechanisms to basically fly the bundles to their predetermined drop zones," Major DeVoe said. "In combat zones right now, JPADS-equipped bundles are being delivered in the 2,000-pound category carrying everything from ammunition to food for troops in remote, hard-to-reach places."

JPADS mission planners have also found a role in improving traditional airdrops as part of the Improved Container Delivery System, or ICDS. "Using their JPADS computer equipment, mission planners are now flying along traditional airdrop missions providing better aerial release points for those bundles as they are dropped from the plane," Major DeVoe said. "They've been able to increase air drop accuracy and altitude for traditional CDS bundles. It's getting better every day with this technology."

As of December 2006, 120 ICDS airdrops and nine JPADS airdrops were completed delivering more than 1,000 bundles to troops on the ground. Major DeVoe said combat operations using JPADS will continue to grow. "This has been successful in Afghanistan and soon we hope it will be further utilized in the Iraq theater of operations," Major DeVoe said.

Precision airdrops could eventually lessen the amounts of convoys military forces undertake in both Iraq and Afghanistan, the major said. "Fewer convoys means less exposure to improvised explosive devices and other hazards troops face on the roads," Major DeVoe said. "That translates to saving lives."

JPADS has been tested and deployed successfully in the 2,000-pound range, Major DeVoe said. However, further testing to airdrop bundles eventually weighing up to 60,000 pounds is expected. "This technology and its applications are only at the beginning," Major Devoe said. "The sky is the limit on where this can go for improving operations on the battlefield."

The overall Department of Defense JPADS initiative is led by the Army, but is a joint effort involving the Air Force, Navy and Marine Corps. The AMWC's involvement has been a significant part of the Air Force's comprehensive effort and AMC's support for the joint development of JPADS will only continue to grow. "This is a revolution in the way air mobility supports the warfighter," General Gray said. "We want to save lives and win the war. This will help us get there."

TOMAHAWK IV FLIGHT TEST SUCCESS FROM USS DONALD COOK

USS DONALD COOK, At Sea (NNS) — A test of a US Navy Tomahawk Block IV cruise missile was conducted Jan. 17 from USS Donald Cook (DDG-75), underway in the Gulf of Mexico.

Seconds after launch from the ship's vertical launch system, the Tomahawk missile transitioned to cruise flight. It flew a fully guided 645-nautical mile test flight using global positioning satellite and digital scene matching area correlator navigation. The one-hour, 30-minute flight concluded at a target and recovery site on Eglin Air Force Base land range.

The Tactical Tomahawk Weapons Control System (TTWCS) provides command and control of the missile during launch and while in-flight. Using TTWCS, the ship can redirect the Tomahawk to a new target during flight. TTWCS has been developed for the Navy by Lockheed Martin, Management and Data Systems in Valley Forge, Pennsylvania.

This marked the first execution of a Tomahawk Block IV test mission into Eglin ranges. "This successful launch of a Tomahawk Block IV missile demonstrates the increased responsiveness and flexibility that the Block IV weapon system brings to the fight," said Tomahawk Program Manager, Capt. Rick McQueen. "We are delivering an unprecedented capability to the warfighter. It also demonstrates the Government/Industry team's commitment to excellence and quality. Our goal is simple - be the Nation's premier strike weapon of choice."

This test also marked the first Block IV launch from USS Donald Cook. Although a first with Block IV, the ship is very familiar with the Tomahawk missile, as it took part in the first strikes in Operation Iraqi Freedom on March 20, 2003. "Donald Cook takes great pleasure to showcase the latest advancements in the Tactical Tomahawk Weapon System," said Cmdr. John M. Esposito, commanding officer of Donald Cook. "This successful test firing proves the legacy of the US Navy's premier weapon system, and shows that it continues to lead the way in uncertain times. The software improvements coupled with the Block IV missile will provide commanders ashore a tremendously flexible system in meeting our warfighting requirements."

The Tomahawk cruise missile is a long range, subsonic cruise missile used for land attack warfare, launched from surface ships and submarines. Tomahawk is designed to fly at extremely low altitudes at high subsonic speeds, and can be flown over evasive routes by several mission tailored guidance systems. Tomahawk missiles are deployed throughout the world's oceans on numerous surface ships and submarines, including AEGIS-class cruisers, guided missile destroyers, and Seawolf and Los Angeles-class submarines.

WSTIAC Success Story:
LONGBOW APACHE BLOCK III

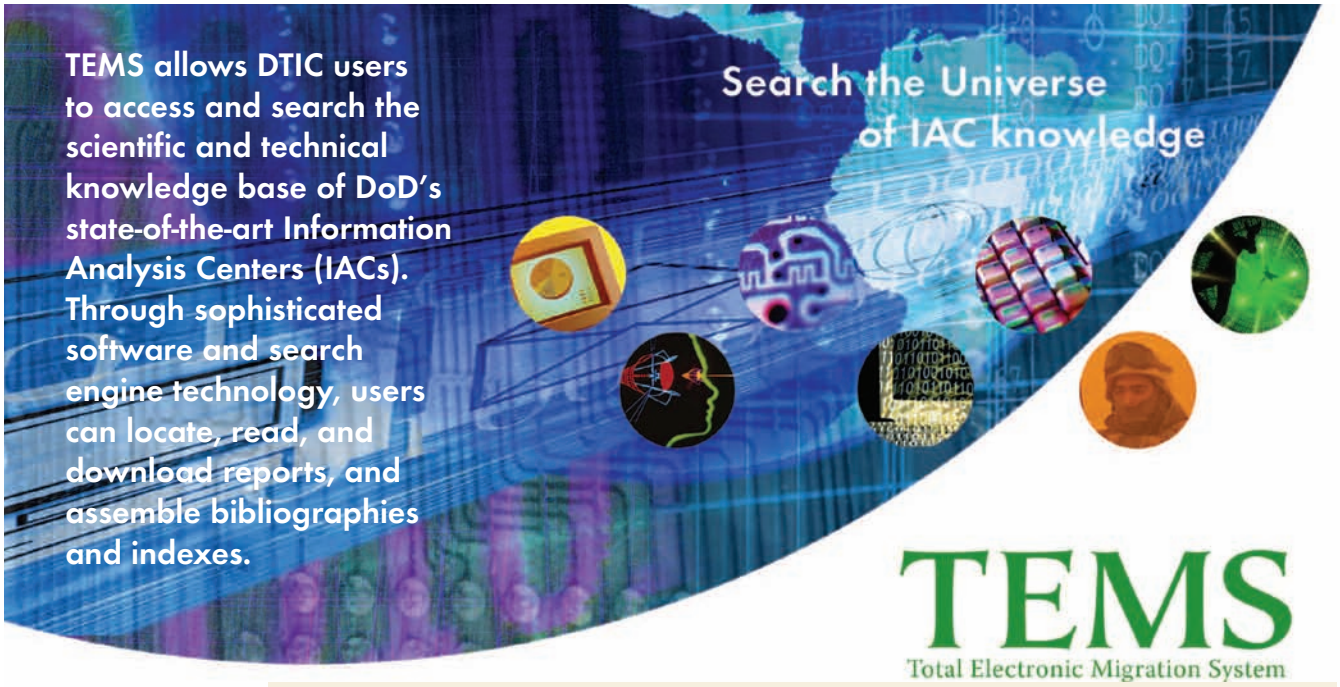
Longbow Apache Block III (AB3) is a combination of twenty-three technologies aimed at enhancing crew effectiveness in battle while reducing operations and support costs. This technology insertion will provide Network-Centric warfare capabilities for the multi-role combat helicopter in the Army's future force. To enable battlespace dominance, the program will incorporate open systems architecture, wideband network communications, extended range sensing, level IV unmanned aerial vehicle control, extended range fire control radar, extended range missiles, and data fusion to merge off- and on-board sensor imagery. In addition, the Longbow Apache Block III will interface with Stryker Brigade Combat Teams and Future Combat Systems through a fully compatible and rapidly reconfigurable open systems architecture mission processor design.

The DoD has recently completed a comprehensive, independent technical assessment and actionable execution plan to assure that the minimum essential requirements are met to support successful entry of the Longbow Apache Block III into System Development and Demonstration (SDD). The WSTIAC Director participated in the overall assessment of the AB3 based on review of documents including Draft Integrated Product Team, Overarching Integrated Product Team, Program Support Review, and contractor briefings and meetings with the government and contractor personnel. Included in the review were the drafts of the Acquisition Strategy Report, Acquisition Program Baseline, Test and Evaluation Master Plan, Systems Engineering Plan, and the Capabilities Development Document. WSTIAC evaluations verified that sound systems engineering principles are being developed and applied allowing the proper tradeoffs between cost, schedule and overall weapon system performance in preparation for Department of Defense approval for the Longbow Apache Block III to enter the production and deployment phase at a Milestone C.

The Longbow Apache Block III effort has been successfully completed. AB3 was approved for entry into SDD on 10 July 2006.

TEMS Update

In Volume 6, Number 3 of the *WSTIAC Newslwtter*, an article providing an overview of the Defense Technical Information Center's (DTIC's) Total Electronic Migration System was published. Since publication of that article in October 2006, there has been significant progress in the development of the system. As of January 2007, TEMS had approximately 124,328 full-text documents available and more than 1,027,600 citations for reference or further request.



To get started

Go to http://www.dtic.mil/dtic/registration/ and follow the instructions. Once registered, visit https://tems-iac.dtic.mil/ to log in to TEMS.

DIRECTED ENERGY WEAPONS (DEW) COURSE

Instructor: Dr. Edward P. Scannell, Alion Science and Technology

Location: Huntsville, Alabama
2007 Course Offerings: 27-28 Feb, 17-18 Jul, 30-31 Oct at 1700 hours

COURSE DESCRIPTION:

This 2 day short course provides an introduction to the basic principles and techniques of Directed Energy Weapons (DEWs). Weapon system applications will also be thoroughly analyzed. The technologies behind each type of DEW will be examined, and the critical path components will be identified and explored with respect to their effect on future DEW development. In addition, advantages that can be achieved by employing DEWs will be discussed, as well as the status of DEW developments and deployments in the international arena. The key DEW programs in High Energy Lasers and RF-DEWs or High Power Microwaves will be fully described.

This short course is provided by the Weapon System Technology Information Analysis Center (WSTIAC). It will be of great benefit to people who need to understand the basic concepts, technologies, design requirements and practical applications of DEWs, including program and business managers, political decision makers, engineers, scientific researchers and military personnel. An undergraduate technical degree is recommended. Mathematics is kept to a minimum, but important formulas are introduced.

These and many other critical questions will be examined:

- What is Directed Energy and what are the different types of Directed Energy Weapons?
- What are the advantages and disadvantages of each type of DEW and what are their target effects and tactical and strategic capabilities?
- How do DEWs work and what are the critical technologies that must be developed for their eventual use in practical systems?
- How may threat DEW effects be countered and how can we protect our own systems?
- What are the major US and international DEW programs that are being pursued?
- What is the prognosis for future DEW development?

ABOUT THE INSTRUCTOR:

Dr. Edward Scannell is a senior member of Alion's technical staff and also serves as WSTIAC's Chief Scientist. Dr. Scannell was Chief of the Directed Energy and Power Generation Division of the US Army Research Laboratory. He has over 30 years of experience in technical areas related to DEWs, including: plasma physics, conventional and alternative energy sources, electromagnetic (EM) guns, particle beam, laser, high power microwave (HPM), and pulse power physics.

SECURITY CLASSIFICATION:

The course is UNCLASSIFIED, but is designated For Official Use Only (FOUO), Export Controlled and attendance is limited to US citizens only.

FEE:

The registration fee for this two day course is $950/student for US government personnel and government contractors. Method of payment is usually credit card (Master Card, VISA, or American Express), but 1556s or a MIPR can also be used.

HANDOUT MATERIAL:

Each student will receive a comprehensive set of course notes covering the material presented.

TRAINING LOCATION:

The course is taught at 6767 Old Madison Pike, Suite 95, Huntsville, AL 35806. WSTIAC can also conduct a dedicated course at your location to reduce your travel time and cost.

For additional information, contact
Mrs. Kelly Hopkins, Seminar Administrator,
at (256) 382-4747 or by e-mail:
khopkins@alionscience.com

Notice: WSTIAC reserves the right to cancel and/or change the course schedule and/or instructor for any reason. In the event of a schedule change or cancellation, registered participants will be individually informed.

INTRODUCTION TO SENSORS AND SEEKERS COURSE

Instructor: Paul Kisatsky, Alion Science and Technology

Location: Huntsville, Alabama
2007 Offerings: 5-7 Jun, 11-13 Sep

COURSE DESCRIPTION:

This 3 day course provides an introduction to the most commonly used sensors and seekers employed in smart munitions and weapons (projectiles, missiles and wide area mines). It is oriented to managers, engineers, and scientists who are engaged in smart weapons program development and who desire to obtain a deeper understanding of the sensors they must deal with, but who do not need to personally design or analyze them in depth. An undergraduate technical degree is recommended. Mathematics is kept to a minimum, but important formulas are introduced. This course also provides an excellent foundation for those scientists and engineers who desire to pursue this discipline to intermediate and advanced levels.

The course covers:

- Classification of seekers and sensors
- Fundamentals of waves and propagation
- Fundamentals of noise and clutter
- Fundamentals of search footprints
- Introduction to infrared
- Introduction to radar
- Introduction to ladar
- Introduction to visionics
- Introduction to acoustics
- Future projections and interactive brainstorming

Noise and clutter, the predominant obstacles to success in autonomous seekers, are given emphasis. The major sensor types are classified and each is discussed. In particular, infrared, radar, optical laser radar (ladar), imaging and non-imaging, and acoustic sensors are individually covered. Of special interest is the discussion on human visionics versus machine recognition, since this concept is of central importance to understanding autonomous versus man-in-the-loop sensing systems. The implications of "artificial intelligence", "data fusion", and "multi-mode" sensors are also briefly discussed. System constraints, which force trade-offs in sensor design and in ultimate performance, are also covered. Time permitting, a projection of future trends in the role of sensors for smart munitions will be presented, followed by a "brain-storming" session to solicit student views.

ABOUT THE INSTRUCTOR:

Paul Kisatsky is a Senior Advisory Scientist with Alion Science and Technology. He is a nationally recognized Subject Matter Expert on sensors and seekers for smart munitions and weapons, and he has more than 40 years of experience in sensors and seekers analysis of modern smart weapons.

SECURITY CLASSIFICATION:

This course is UNCLASSIFIED, but is designated Export Controlled and attendance is limited to US citizens only.

FEE:

The registration fee for this 3 day course is $950/student for US government personnel and government contractors. Method of payment is usually credit card (Master Card, VISA, or American Express), but 1556s or a MIPR can be used.

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SMART/PRECISION WEAPONS COURSE

Instructors: Mr. Hunter Chockley and Mr. Bob Fitzgibbon
Alion Science and Technology

Location: Huntsville, Alabama
2007 Course Offerings: 24-26 Apr, 7-9 Aug, 13-15 Nov
(Course starts at 0800 Tuesday and ends at noon on Thursday)

COURSE DESCRIPTION:

This 2 1/2 day short course provides a general understanding of smart weapons and related technologies. This course is aimed at providing general knowledge about smart weapons technology and a source of current information on selected US and foreign smart weapons, to include system description, concept of employment, performance characteristics, effectiveness and program status.

A variety of ground, sea and air smart/precision weapon systems are discussed, to include fielded and/or developmental US systems such as Joint Direct Attack Munition (JDAM), Joint Standoff Weapon (JSOW), Joint Air-to-Surface Standoff Missile (JASSM), Advanced Medium Range Air To Air Missile (AMRAAM), Javelin, Excalibur, Precision Guided Mortar Munition (PGMM), High Speed Anti-Radiation Missile (HARM), Tomahawk, Standoff Land Attack Missile – Expanded Response (SLAM-ER), Small Diameter Bomb (SDB), Cluster Bomb Munitions and Non Line of Sight – Launch Systems, among others, as well as representative foreign smart/precision weapons.

The objective of this course is to inform materiel and combat developers, systems analysts, scientists, engineers, managers and business developers about smart/precision weapons, to include:

- State of the art of representative US and foreign smart weapons systems;
- Employment concepts;
- Smart weapons related systems, subsystems, and technologies; and
- Technology trends.

ABOUT THE INSTRUCTORS:

Mr. Hunter Chockley is a Science Advisor with Alion. He has more than 35 years of experience with weapons technology and/or smart/precision weapons. He has conducted advanced concept studies, and weapon system/ subsystem assessments

Mr. Bob Fitzgibbon is a Science Advisor with Alion and he has 27 years in system analysis and design. He has actively worked ECM, RF and RWR programs as well as hardware modernization efforts.

SECURITY CLASSIFICATION:

The course is UNCLASSIFIED, but is designated For Official Use Only (FOUO), Export Controlled and attendance is limited to US citizens only.

FEE:

The registration fee for this 2 1/2 day course is $950/student for US government personnel and government contractors. Method of payment is usually credit card (Master Card, VISA, or American Express), but 1556s or a MIPR can be used.

HANDOUT MATERIAL:

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WEAPONEERING COURSE

Instructor: Professor Morris Driels, Naval Postgraduate School

Location: Huntsville, Alabama
2007 Offerings: 13-15 Mar, 28-30 Aug
(Course starts at 0800 Tuesday and ends at noon on Thursday)

COURSE DESCRIPTION:

This 2 1/2 day short course is based on a very successful graduate-level weaponeering course developed by Professor Driels and taught at the Naval Postgraduate School, Monterey, CA. The course will provide an overview of the fundamentals of the weaponeering process and its application to air-to-surface and surface-to-surface engagements. The course explains the analytical basis of current weaponeering tools known as the Joint Munitions Effectiveness Manuals (JMEM's) produced by the Joint Technical Coordinating Group for Munitions Effectiveness (JTCG/ME). The JMEM's are used by all Services to plan offensive missions and allow the planners to predict the effectiveness of selected weapon systems against a variety of targets.

The short course is divided into three parts. Part I covers the basic tools and methods used in weaponeering:

- The weaponeering process
- Elementary statistical methods
- Weapon trajectory
- Delivery accuracy of guided and unguided munitions
- Target vulnerability assessment

Part II covers the weaponeering process for air-launched weapons against ground targets:

- Single weapons directed against point and area targets
- Stick deliveries (point and area targets)
- Projectiles (guns and rockets)
- Cluster munitions
- Weaponeering for specific targets: bridges, buildings etc.)
- Collateral damage modeling

Part III covers the weaponeering process for ground engagements:

- Indirect fire systems – artillery and mortars.
- Direct fire systems – infantry and armored vehicles.
- Mines – land and sea.

ABOUT THE INSTRUCTOR:

Morris Driels is a Professor of Mechanical Engineering at the US Naval Postgraduate School (NPS) in Monterey California. He has worked with the JTCG/ME on a variety of topics in support of the JMEM's for a number of years. He has taught a quarter long weaponeering course at NPS for three years and has published a text book on the subject.

SECURITY CLASSIFICATION:

The course is UNCLASSIFIED but is Export Controlled and attendance is limited to US Citizens only.

FEE:

The registration fee for this 2 1/2 day course is $950/student for US government personnel and government contractors. Method of payment is usually credit card (Master Card, VISA, or American Express), but 1556s or a MIPR can be used.

HANDOUT MATERIAL:

Each student will receive a textbook and a set of handouts which covers the material presented.

TRAINING LOCATION:

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calendar of events

Upcoming Conferences and Courses

February 2007

Warfighter's Vision 2007: Winning the Global Fight
21-22 February 2007
Alexandria, VA
For additional information:
http://www.afei.org/brochure/7a04/index

18th Annual Special Operations/Low Intensity Conflict Symposium
26-28 February 2007
Arlington, VA
For additional information:
http://eweb.ndia.org/eweb/DynamicPage.aspx?Site=ndia&Webcode=EventList

March 2007

Directed Energy Systems Symposium
19-23 March 2007
Monterey, CA
For additional information:
http://www.deps.org/DEPSpages/DESystemsSymp07.html

Annual US Missile Defense Conference
19-23 March 2007
Washington, DC
For additional information:
http://www.aiaa.org/content.cfm?pageid=230&lumeetingid=1475

2007 DTIC Conference
26-28 March 2007
Alexandria, VA
For additional information:
http://www.dtic.mil/dtic/annualconf/

April 2007

2007 Joint Service Power Expo
23-26 April 2007
San Diego, CA
For additional information:
http://www.ndia.org/Template.cfm?Section=7670

Gun and Missile Systems Conference & Exhibition
23-26 April 2007
Charlotte, NC
For additional information:
http://eweb.ndia.org/eweb/DynamicPage.aspx?Site=ndia&Webcode=EventList

May 2007

Small Arms Symposium
7-10 May 2007
Virginia Beach, VA
For additional information:
http://www.ndia.org/Template.cfm?Section=7610

AIAA Aerodynamics Decelerator Systems Technology Conference & Seminar
21-24 May 2007
For additional information:
http://www.aiaa.org/content.cfm?pageid=230&lumeetingid=1443&viewcon=overview

June 2007

34th IEEE International Conference on Plasma Science
17-22 June 2007
Albuquerque, NM
For additional information:
http://www.ece.unm.edu/ppps2007/index.htm

20th Annual Solid State and Diode Laser Technology Review
26-28 June 2007
Los Angeles, CA
For additional information:
http://www.deps.org/DEPSpages/SSDLTR07.html

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Email: iac@dtic.mil
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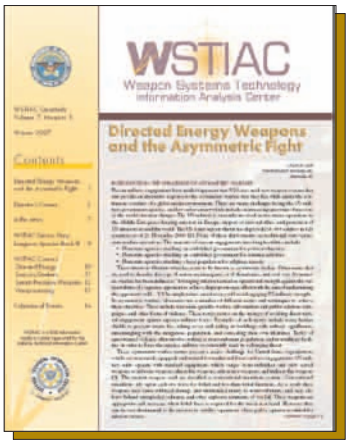

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Inside this issue

Directed Energy Weapons
and the Asymmetric Fight
Director's Corner
in the news
WSTIAC Success Story
WSTIAC Courses
Calendar of Events