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THE EVOLUTION OF NON-LETHAL WEAPONS—WHERE WE WERE, WHERE WE
ARE, AND WHERE WE COULD BE

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Executive Summary

Title: THE EVOLUTION OF NON-LETHAL WEAPONS—WHERE WE WERE, WHERE WE ARE, AND WHERE WE COULD BE

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Thesis: The use of directed energy Non-Lethal Weapons in all phases of military operations can enhance mission effectiveness while simultaneously setting more favorable conditions for post-combat activities.

Discussion: More often than not service members associate the use of Non-Lethal Weapons (NLW) with “police type” operations during phases IV (Stability) or V (Enabling Civil Authority). Very little time is devoted to educating the force on the utility of NLWs in all phases of military operations. As a result, requirements are not being generated, which in turn limits the investments and prioritization made by military organizations to advance or invest in NLW technology. The United States military possesses the technological capacity to close many of the capability gaps with respect to counter personnel and counter materiel NLWs. However, this technology is considered to be highly controversial due to misconceptions that are fueling the reluctance of senior civilian and military leadership to use directed energy weapons systems such as the Active Denial System (ADS) operationally. There is no question about the effectiveness of the weapon system; in its current configuration ADS produces a non-lethal effect that is unmatched by any other NLW that is a program of record. Imagine what would happen if investments are made to advance the system beyond the current configuration reducing the size, weight, power, and cooling (SWaP-C). The benefits of investing in this technology not only provide a tactical advantage but an operational and strategic one as well. Waging war and winning is one thing. Waging war and winning, while preserving life and limiting collateral damage is another. In the court of public opinion, the latter would garner the most support from not only the American people but also those non-combatants of the hostile country.

Conclusion: The benefits of considering and integrating NLWs early in the operational planning and execution will lead to a decrease in civilian casualties and a reduction in collateral damage to civil infrastructure by the United States or coalition forces. Currently fielded NLWs are limited to short range “low tech” blunt impact munitions that offer limited utility, or in the case of counter materiel systems, they are bulky devices that are not conducive to all operating environments requiring deployment in front of a vehicle or vessel. However, with the advancement in directed energy technology, commanders will have at their disposal NLWs that complement not only lethal fires but also change the dynamics of how the Joint Force fights.

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Introduction

The United States military must frequently wrestle with situations that require the application of force proportional to a given circumstance. In major combat operations, the choice to exercise lethal options seems rudimentary. However, the situation becomes even more complicated when terms such as proportionality, collateral damage, avoid civilian casualties, and escalation of force are used. Commanders must make every attempt to operate within the confines of the law of armed conflict (LOAC), rules of engagement, and standard operating procedures (SOP) to ensure the aforementioned terms are nested within their concept of operations and schemes of maneuver. The use of non-lethal weapons is more often than not an afterthought by the United States military, usually considered in academic environments but not operationally. Commanders frequently fail to understand and/or capitalize on the utility of these types of weapons or systems and how they can be used to enhance mission effectiveness in support of not just the tactical objectives, but the operational and strategic ones as well.

As one of the most influential instruments of national power, the United States military must be prepared to operate in an increasingly complex security environment as it protects America's vital interests at home and abroad.¹ This complex environment possesses many challenges for those who shoulder the burden to protect these vital interests and its citizens. Since the conclusion of Operation Desert Storm, the United States military has increasingly found itself involved in operations other than full spectrum conflicts with most of these operations occurring in densely populated urban areas or mega-cities.² There is no question that American service members are well trained and equipped for the kinetic fight where the application of lethal force is required. However, the unanswered question lies with whether or not military leaders are providing the appropriate training and equipment to their units as they

prepare for missions that are not linear, and plagued with ambiguity when operating in increasingly complex security environments.

The 2018 National Defense Strategy identifies three strategic approaches to ensure the security of the United States' vital interests and allies across the globe. They include building a more lethal force, strengthening alliances and attract new partners, and reform the department for greater performance and affordability.³ The first of these tenets is for the Department of Defense (DOD) to focus on building a more lethal force capable of defeating a near-peer or peer competitor.⁴ Without applying any critical thought to what building a “more lethal force” means, if senior military leaders fail to consider or employ certain types of weapons or systems during the kinetic fight, then there could be unintended consequences that severely hinders the operations as forces transition between the different phases, particularly during post-combat operations.

Units must be prepared for operations across the entire range of military operations (ROMO) as depicted in Figure 1 below. It is imperative that the DOD continues to invest in technology to maintain the asymmetric advantage over potential adversaries or competitors. These investments should include further development, testing, fielding, sustained training, and education about the utility of Non-Lethal Weapons (NLW). Incorporating the use of directed energy NLWs into operational planning for missions across the entire spectrum of conflict can and will vastly improve mission effectiveness, while simultaneously setting more favorable conditions for post-combat operations.

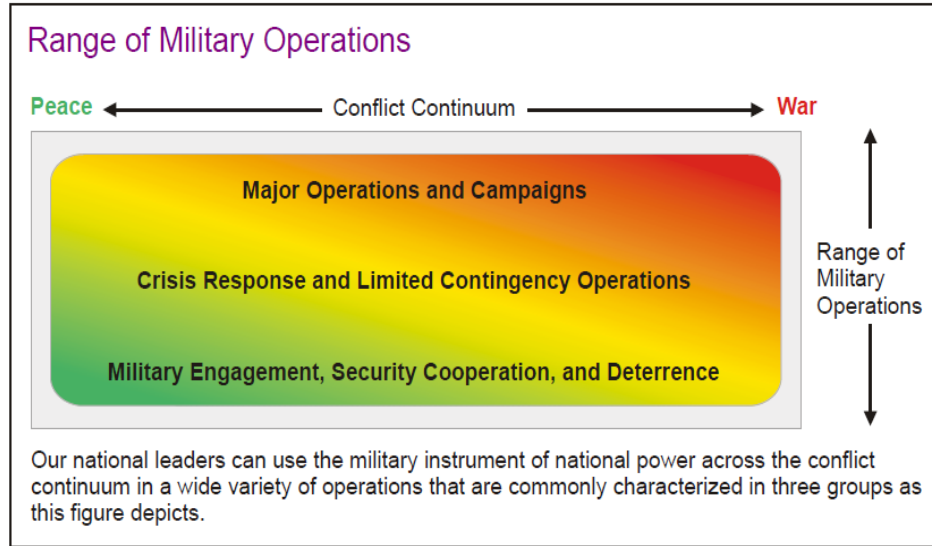


Figure 1. Notional Operations across the Conflict Continuum

Source: Chairman Joint Chief of Staff, "Doctrine for the Armed Forces of the United States," *Joint Publication 1*, March 25, 2013.

Methodology

To support the thesis of this study, it is prudent to provide a background of how and why the United States military adopted NLWs, the roles, and responsibilities of the Joint Non-Lethal Weapons Directorate (JNLWD), the different categories of NLWs, and the process by which NLWs are developed and authorized for military use. Additionally, an assessment of currently fielded legacy NLWs and future (advanced) NLWs—specifically the use of directed energy weapons in historical cases such as Operations Iraqi Freedom and Enduring Freedom—will be used to illustrate the potential benefits to operational commanders in all phases depicted in Figure 2, not just in phase IV and V operations. This study will also address the obstacles and apprehensions that are inherently common when utilizing a directed energy weapon against a human subject, in particular, the lack of policy support of counter personnel directed energy NLWs such as the Active Denial System (ADS). It will conclude with a suggested path forward concerning the advancement of directed energy NLWs and its inclusion in full spectrum conflict.

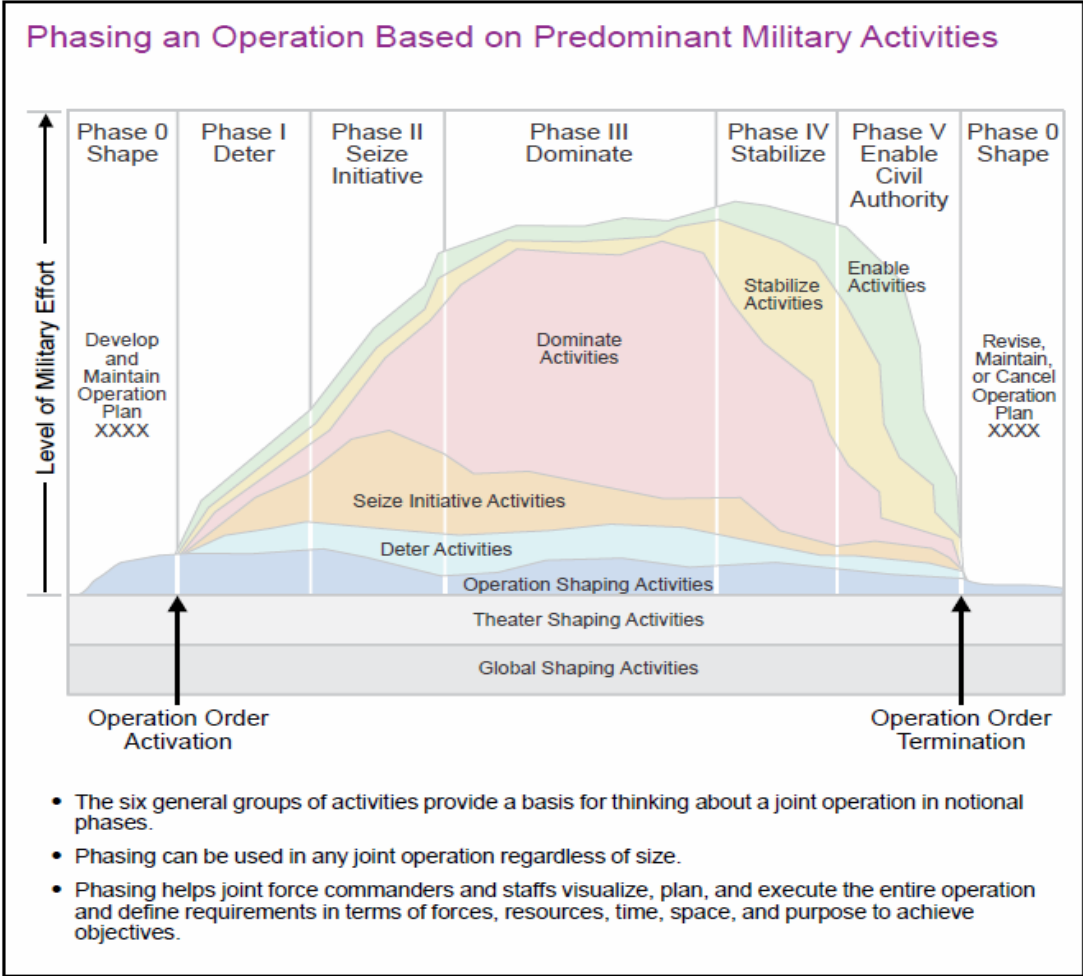


Figure 2. Phasing an Operation Based on Predominant Military Activities
 Source: Chairman Joint Chief of Staff, "Joint Operations," *Joint Publication 3-0*,
 January 17, 2017.

The Evolution of NLWs within the United States Armed Forces

Paving the Way for NLWs

History has shown that humankind sought to gain an asymmetric advantage over an adversary in almost all conflicts. As the world became industrialized the accuracy, lethality, and destructive power of weapon systems grew exponentially.⁵ Although the deadly force of these new weapon systems was effective at achieving a military objective, they often created unnecessary suffering for the local populace and a much more significant burden for coalition forces during phases IV and V operations. During an interview with Amy Truesdell, the author of *The Ethics of Non-Lethal Weapons*, Peter McAleese (a former British SAS soldier) asked her a very straightforward, yet fascinating question—“if there is another way to achieve the same objective in a conflict without resorting to lethal means, why would you not use it?”⁶

The use of NLWs by the armed forces is not a novel concept. The chemical irritants developed during World War I were later adopted by civilian law enforcement around the world for the purpose of controlling riots.⁷ It wasn't until the conclusion of the first Gulf War in 1991 that the DOD explored the idea of developing non-lethal technologies and doctrine as a tool for the warfighter.

The modern use of NLWs by the DOD can be traced back to operations in the war-torn country of Somalia. In 1992, the United Nations (UN) established Security Council Resolution (SCR) 794 in response to the humanitarian crisis in Somalia. With the United States in the lead, the UNSCR 794 established a Unified Task Force (UNITAF) to create a secure environment for the delivery of humanitarian aid to war-torn Somalia.⁸ As the political situation further deteriorated in Somalia in 1995, the UN decided the environment was no longer safe for its peacekeepers and ultimately withdrew its aid workers. Leading the operation from Somalia,

Lieutenant General (LtGen) Anthony Zinni acknowledged that United States forces were not equipped to effectively deal with the withdrawal without causing collateral damage to personnel and materiel. Local Somali factions would use women and children as human shields during attacks on UN forces to avoid capture.⁹ While conducting the withdrawal, the United States Marines assigned to the UNITAF in support of Operation United Shield had to adopt technologies and develop tactics that would provide them with more options than they currently had.

Unlike many other officers who favored other more sophisticated weapon systems, LtGen Zinni became a staunch supporter of NLW technology after several Marine reservists who worked for the Los Angeles Police Department (LAPD) brought the idea to him. Utilizing existing non-lethal systems that were in use with the LAPD, the Marine Corps examined the military utility of such NLWs as an option for the withdrawal from Somalia. The NLWs that were in use at the time were primarily designed for crowd control and subduing of belligerent actors.¹⁰ The Marines assigned to the UNITAF deployed with a complement of rudimentary NLWs but never had the opportunity to employ them. A robust public affairs campaign informing locals about the new weapons and capabilities the Marines had was enough to deter the factions from resorting to violence. The results of this action garnered the support of not only senior Pentagon officials, the media, and citizens, but it also led to the integration of NLWs into the arsenal of weapons used by the United States Military.

Emerging Requirements

On today's battlefield success cannot be measured solely by the overwhelming use of force against the adversary or enemy casualties. It is also a measure of how friend units apply (scalable) force or exercise restraint in a given situation that would set the conditions necessary

for a smooth and rapid transition to civil authority. It is imperative that as an organization the DOD provides its young warfighters with the equipment needed to ease the burden of decision making that could have strategic implications.

To ensure synergy and prevent duplication of efforts by the different services within the DOD, the 1996 National Defense Authorization Act (NDAA) directed that the DOD should provide improved budgetary focus and management direction to the NLW Program.

Furthermore, the 1996 NDAA directed the Secretary of Defense to, “centralized responsibility for development (and any other functional responsibility considered appropriate) of nonlethal weapons technology to an existing office within Office of the Secretary of Defense or to a military service as the executive agent.”¹¹

The Roles of JNLWD

In 1996, the DOD issued the formal United States policy for the use of NLWs. DOD Directive 3000.3 established the roles and responsibilities of stakeholders within the department to develop, deploy, and implement NLWs into their service-specific doctrine. It also approved the Commandant of the Marine Corps (CMC) as the DOD’s Executive Agent for NLWs. In this capacity, the CMC is responsible for stimulating and coordinating the NLW’s requirements for all services.¹² He is also responsible for establishing a focal point to ensure the best investments are made for future non-lethal technologies within the department. In 1997 the DOD established the Joint Non-Lethal Weapons Directorate (JNLWD) in Quantico, VA to assist the executive agent by managing the day-to-day activities of the DOD’s NLWs program.

Since its inception, JNLWD has invested approximately 919 million dollars in developing, operationalizing, and transitioning over 50 NLWs for use within the DOD. Additionally, significant investments have been devoted to researching the next generation of

directed energy weapons and systems; conducting exercises, demonstration, and congressionally mandated military utility assessments; training and education for both officer and enlisted; and the characterization of the human effects of potential weapons or systems.¹³

The JNLWD collaborates with many different entities including all branches of the military, the United States Coast Guard and the United States Special Operations Command; the Geographic Combatant Commands; other agencies within the DOD; the Departments of State, Homeland Security, and Justice; and other government and non-government organizations with interest in non-lethal weapons development.¹⁴

Definition and Categories of NLWs

There are many different definitions of NLWs used by various military entities across the world, but, for the purpose of this study, the definition sanctioned by the DOD will be used.

NLWs are defined as weapons, devices, and munitions that are explicitly designed and primarily employed to incapacitate targeted personnel or materiel immediately, while minimizing fatalities, permanent injury to personnel, and undesired damage to property in the target area or environment. Non-lethal weapons are intended to have reversible effects on personnel and materiel.¹⁵

It is important to note that other capabilities produce non-lethal effects such as information, electronic, and psychological warfare. However, only those NLWs and systems that fall under the auspices of JNLWD will be considered in this study. NLWs are categorized into two distinct groups: counter personnel—those weapons that are used to modify the behavior of human targets, and counter materiel—weapons or systems that disable or stop a vehicle or vessel from functioning as designed. The goal when incorporating these NLWs into operational planning or standard operating procedures is not to replace lethal systems, but to provide commanders a range of options that produce varying results. These results include modifying behaviors without

causing significant injury or death or creating standoff distance to allow more time for making decisions.

It has been estimated that there were well over 170 million casualties due to various conflicts around the world this century, with an astounding 80 million civilians killed due to military necessity.¹⁶ Modern-day commanders fight much differently than their predecessors; the appetite for mass destruction and substantial casualties have become less appealing.¹⁷ When democracies conduct military operations, there is an expectation that it will involve as little bloodshed as possible. This is especially true when operating under the authority of the United Nations.¹⁸ There are two possible solutions to avoid needless bloodshed and undue suffering: the first is to deal with situations with the other instruments of national power (diplomatic, information, and economic) and avoid conflict at all costs, and the other is to incorporate NLWs into all phases of military operations. With the former being highly unlikely, it is imperative that the United States military continues to invest in the advancement of NLWs; develop NLWs tactics, techniques, procedures; and incorporate NLWs into their training continuum for full spectrum conflicts to provide scalable means in the application of force.

Development of NLWs for use in the military

The DOD has made significant progress over the years with developing and fielding NLWs. However, based on the latest Joint Non-Lethal Effects Capabilities Based Assessment in 2008 (revalidated in 2013) it was noted that there were substantial counter personnel and counter materiel capability gaps within DOD.¹⁹ The JNLWD identified an area known as the “Precision Incapacitation Gap and Precision Challenge Area.” This gap/area identified the region that is beyond the range of many of the currently fielded blunt impact munitions.²⁰ The challenge for industry or government laboratories is developing blunt impact munitions that are not only

effective within the precision incapacitation gap area but are also safe enough to engage a human target at close range without causing irreversible damage or death. Creating new “low tech or low cost” munitions that can be suitable to fill this critical capability gap may be a bridge too far.

Advanced NLW technologies have made it possible to eliminate the for the void in the precision incapacitation gap. If the technology exists, why does the capability gap still exist? The United States Air Force, in conjunction with JNLWD, developed a highly sophisticated counter personnel directed energy NLW known as the Active Denial System (ADS). From the early 2000s thru 2008 two Advanced Concept Technology Demonstrators were developed, ADS-1- mounted on a modified High Mobility Multi-Purpose Wheeled vehicle, and ADS-2 a more ruggedized version suited for operational used. This weapon system can safely and effectively engage human targets at ranges up to 1000 meters. So why is ADS not a common term in the vernacular of operational commanders and military planners? Why has this system not yet been fielded? Why is there an apprehension by senior Military and Civilian leaders to endorse counter personnel directed energy NLW? After all, the ADS has satisfied all the requirements to be considered a legal weapon for use by the United States Military.

As previously mentioned, NLWs must meet very stringent criteria before being approved for use by the United States military—they are explicitly intended to incapacitate targeted personnel or materiels while minimizing undesired collateral damage. These NLWs are expected to deliver the appropriate level of force that elicits an immediate response to the targeted individual or object.²¹ Developers of traditional lethal weapons face different challenges than those who develop NLWs or systems; the expectation when lethal fires are used is death or gross physical destruction. NLWs are different because the non-lethal effects must meet the definition of reversibility—in this context the subject or target must be able to return to their or its pre-

engagement condition respectively.²² The burden of proof lies with the developer's ability to demonstrate that new NLWs will conform to the DOD's definition of NLWs and do so consistently. To meet the criterion for counter personnel NLWs, any injury sustained during an engagement must be treatable via first aid. Any damage sustained during an engagement with a counter materiel system or weapon must be able to be repaired at the organizational level of maintenance.²³

All NLWs utilized by the DOD must also conform to conventions and international laws to which the United States Government is a signatory. One such example is Riot Control Agents (RCA). The inclusion of RCAs in the Chemical Weapons Convention has created a layer of bureaucracy that inhibits the use of a relatively innocuous agent. To this day, the authority to utilize RCAs lies with the President of the United States during times of war.²⁴ Due to this policy, commanders are less compelled to employ RCAs in a situation where it can be beneficial or warranted. Emerging technology is sometimes misunderstood, thereby creating unnecessary obstacles or policies that are so restrictive that military commanders and planners refuse to utilize them unless directed to do so.

Limitations of currently fielded NLWs

Counter Personnel Systems

The use of non-lethal weapons in military operations such as humanitarian assistance/disaster relief, non-combatant evacuations, and low-intensity conflicts has repeatedly proven its efficacy in achieving not only tactical objectives but operational and strategic ones as well. If used appropriately NLWs can also be very useful in full spectrum conflict as an enhancement to lethal options. Counter personnel NLWs such as optical lasers, acoustic hailing devices, blunt impact munitions, electronic control devices (TASERs), RCAs, and malodorants

can provide operational commanders the trade space needed even when conducting phase II (seize the initiative) and III (dominate) operations.

Consider the instance where a unit was assigned a task to seize and hold an objective. However, the geography does not permit bypassing the urban centers; the unit must now maneuver through narrow streets in a densely populated area to the objective. The route takes the team through an area where the pedestrian traffic is relatively heavy, and the residents do not welcome the intervention of coalition forces in their country. There have been no attacks thus far on coalition forces; however, intelligence reports show that the local population is becoming increasingly agitated towards coalition forces transiting through the area due to an uptick in vehicular and pedestrian accidents. Standard operating procedures require elements to maneuver quickly through the area to avoid any unnecessary engagement. What tools can a commander provide to the warfighters that would preserve life [coalition forces and the local populace] and allow the units freedom of maneuver?

Currently fielded NLWs can achieve limited success in this type of operating environment; however, they are not precision systems. Extreme care must be taken to avoid striking the individual target in the head, neck, or groin areas while ensuring the subjects are outside of the minimum safe distance. Failure to employ NLWs as intended can have deadly consequences. As in the case of Victoria Snelgrove who was accidentally killed in October 2004 when she was struck in the eye by a blunt impact non-lethal munition during a riot following a major league baseball game.²⁵ The United States Military is not immune to these misfortunes. Accidental deaths at the hands of the United States military does not exude confidence to the indigenous people.

A possible solution in this scenario is the use of an ocular interrupter or eye safe green laser dazzler to gain the attention of the individuals. However, the performance characteristics of laser dazzlers are severely degraded during daylight hours. Another device that could be used is an acoustic hailing device, however, the effects are not as compelling as some of the more advanced NLWs being developed. Due to the limitations of the legacy NLWs, training is often reserved for those units conducting police-type operations. Combat forces seldom incorporate NLWs into their training continuum.

Counter Materiel Systems

There have been trends that indicate future military operations will occur in large urban areas or megacities versus the vast open deserts or mountainous regions such as Afghanistan.²⁶ Another situation to grapple with involves large combat formations or logistic trains transiting through areas heavily congested by vehicular traffic. Most of the time people would move out of the way to avoid confrontation; however, there are some that may not comply with posted signage or verbal cues. How are forces to react to those who are not compliant? Deadly force may not be an option because the operator's action does not meet the threshold to warrant such force, i.e., hostile act or intent.

Warfighters today must not only focus on the tactical mission, but they are also required to have an understanding of the overall operational and strategic objectives. The wrong decision at the individual up to the company level can have the potential to have grave consequences at the operational or strategic levels. Such was the case where American troops inadvertently burned copies of the Koran in February 2012 sparking violent and deadly protests in Afghanistan.²⁷ It is imperative warfighters understand that actions at the tactical level can have negative strategic implications. How should forces react to the impediments they face along their

route? If they wait for the traffic to move, they become a much easier target, but if the unit moves through the area with little regard to the property of the indigenous people they may risk the chance of exacerbating an already volatile situation.

Counter materiel non-lethal devices have the potential to stop a non-compliant vehicle that is aggressive to friendly forces but not deemed hostile. A counter materiel system, such as the vehicle lightweight arresting device (VLAD), will physically stop a car or small truck without harming the occupants or causing significant damage to the vehicle itself. The VLAD is a pre-emplaced, portable, expandable spiked net that is capable of stopping a 5,500-pound wheeled vehicle traveling at 30 mph within 200 feet.

When a vehicle runs over the VLAD, the spikes puncture and grab the tires, the net then become entangled around the wheels and axle, thereby impeding its forward motion. This system will work well for entry control points, vehicle checkpoints, or if there is ample time and space for it to be employed. The vehicle is unable to be relocated until the VLAD is untangled and removed. Friendly troops are now vulnerable to possible enemy attack as they attempt to remove the entangled VLAD.

Current counter materiel NLWs or systems are not well suited for fixing or temporarily blocking a vehicle as the convoy maneuvers. Accepting this capability gap will undoubtedly lead to unnecessary collateral damages as friendly forces operate within close proximity to indigenous personnel. Advanced directed energy counter materiel NLWs would be very beneficial in the scenario previously mentioned.

NLW in Iraq and Afghanistan

The two scenarios mentioned above are not fictitious vignettes or concepts of operations developed by think tanks; they were actual situations that coalition forces faced during

Operations Iraqi and Enduring Freedom. In the early stages of the conflict, many units were focused on the kinetic fight while moving to their objective area rather quickly. Warfighters sometimes found themselves in ambiguous situations without the equipment or knowledge [options] to respond appropriately when dealing with belligerents who did not meet the threshold for lethal force but still posed a threat. The Rules of Engagement (ROE) in the United States Central Command's Area of Responsibility (AOR) prohibited the use of warning shots to gain the attention or alter the behavior of noncompliant personnel.

Phase II and III operations are inherently dangerous; commanders must develop predeployment training plans that would prepare their units for the many ambiguous situations they will face on the battlefield. Additionally, with the risk to force and risk to mission associated in this operating environment, the commander may not dedicate the time to train with NLWs because his men are focused on building their proficiency with lethal systems. Failure to incorporate NLWs into a unit's training continuum could have unintended consequences that negatively impact the operational and strategic objectives of a specific operation. Organizations that incorporate NLWs into their training continuum and operational planning will be better suited to deal with ambiguous situations when the ROEs or condition prohibits the use of lethal options.

The operational environment in which war is waged has changed from era to era, but from the jungles of Vietnam to the mountains of Afghanistan there is one thing that has remained constant. The civilian population suffers the most, be it the disruption of essential services [water, electric, etc.] or the physical destruction of private property due to military necessity and injury or death from combat actions. This approach does not foster an environment that would be beneficial to coalition forces at the end of combat operations. The use of NLWs not only reduce

collateral damage to infrastructure, and minimize civilian casualties, but more importantly, produce tangible results without jeopardizing the military mission or endangering the lives of coalition forces.

Units assigned to United States Central Command AOR had to complete a rigorous pre-deployment training regime before their arrival. This training included area specific language and cultural awareness, and NLW familiarization instruction for those conducting missions that required them. Commanders must prioritize other training requirements as they prepare their units for operations in a combat zone; faced with competing priorities—which Mission Essential Tasks (METs) should be the focus of attention? As commanders are morally obligated to ensure the well-being of those in their charge, the primary focus of their unit's training was on tasks designed to increase lethality and combat proficiency. A USMC rifle battalion serves as a good example. The battalion is required to be proficient with performing four different METs,²⁸ with little to no emphasis on incorporating NLWs into the training beyond ROE and LOAC references. As a force that employs maneuver warfare to gain an asymmetric advantage, why is there an apprehension to use NLWs as another tool for force application in this type of warfare to enhance mission effectiveness?

As seen in many of the after-action reports from Iraq and Afghanistan, it was clear that utilizing NLWs would have proven beneficial in many situations.²⁹ Some units were familiar with the various types of NLWs and systems but rarely were they proficient with the employment of them in the larger scheme of maneuver. While operating in the urban areas of Iraq, many units became bogged down due to their inability to move non-combatants out of the way. There was also a problem with dealing with approaching vehicles and determining the intent of the occupants. Those units that employed NLWs during combat operations or support

roles were enamored by the results;³⁰ they now include more than just a familiarization with NLWs as they prepared for future deployments.

With the ROEs prohibiting service members from utilizing warning shots to determine intent, how could they have reacted or what tools were available to deal with the situation at hand effectively? If unit training before arrival in the AOR included more than a brief introduction to NLWs and possibly a “Familiarization Fire,” then commanders could have developed TTPs incorporating NLWs that would provide the ability to create the time and space needed when faced with ambiguous situations during combat missions. Although collateral damage is acceptable during a conflict, why is it, as the most advanced and professional military in the world, a capability gap still exists when there are materiel solutions available to fill the said gaps?

It could be argued that many of the civilian casualties caused by coalition forces could have been prevented if the appropriate tools were provided. The United States is well versed in the conduct of war; however, the ability to successfully transition to civil authority can be questioned. Many factors must be considered for a successful transition to occur, but when a commander fails to take into consideration follow-on operations, the humanitarian care and rebuilding efforts that follow could be monumental tasks. One of the contributors is the lack of trust between indigenous populations and coalition forces due to the gross physical destruction and accidental deaths that occurred during combat operations. How do coalition forces regain that lost trust of the indigenous population? Incorporating the appropriate type of NLWs into phases II and III operations to minimize civilian casualties and damage to the infrastructure is one of the important benefits of NLWs.

Another situation coalition forces faced was dealing with combatants that were indistinguishable from the civilian population. Many would launch attacks on friendly forces and disperse into crowds essentially using civilians as human shields. Others may seek refuge in religious facilities. ROEs prevented United States forces from pursuing or engaging individuals unless they were actively involved in hostile activities, and even then, the higher echelons of command retained the authority to pursue or engage a target in religious structures. Admittedly, current NLWs' capabilities may not be effective at engaging targets in the situation above; however, advanced technologies such as a directed energy counter personnel system would be well suited.

Future or Advanced NLW Capabilities

The premise behind using NLWs is to change the physical behavior of a person or group of people without causing irreparable harm or in the case of counter materiel systems render the object [boat, car, aircraft, etc.] unusable for a specified period.³¹ Legacy blunt impact munitions are also limited by its effective range, which is well within the range of small arms. These munitions can be quite effective at motivating non-compliant individuals through pain but can pose a risk of significant injury if not properly employed.³² In fact, if a target is engaged within the minimum safe distance, the consequences can and have been fatal.³³ JNLWD has recognized the potential risk of significant injury and is working with its industry partners to pursue technologies that can deliver non-lethal effects at ranges much greater than systems that are currently fielded. These developmental systems are expected to provide non-lethal effects well within the range of the precision incapacitation gap or precision challenge area and outside of the range of enemy small arms fire.

It is widely known that traditional NLWs are limited in their effects and capabilities. However, directed energy systems such as the ADS, the Radio Frequency Vehicle Stopper, and Radio Frequency Vessel Stopper are potential game changers. These directed energy systems provide commanders with an unmatched asymmetric advantage without causing permanent harm to targeted individuals, vehicles, or vessels. The most technologically mature of the three systems previously mentioned is the Active Denial System.

The Active Denial System

The ADS is a highly advanced, counter personnel directed energy non-lethal weapons system. Unlike traditional munitions that achieve non-lethal effects through a kinetic means, ADS produces the desired “repel effect”³⁴ by the use of radio frequency energy. When engaged, the belligerent actors or non-combatants experience an intense heating sensation that compels them to change their behavior or remove themselves from the area immediately. The effectiveness of ADS on human subjects is universal: unlike traditional NLWs, such as electronic control devices (TASER) or irritants, where the effects depend primarily on the individual's threshold for pain. The psychological impact of a burning sensation can be quite compelling, especially when the target does not expect it, know what is causing it, or know where it originated.

ADS is often referred to as a microwave weapon; however, this a misnomer. When considering the electromagnetic spectrum, ADS operates at 95GHz and falls within the range of millimeter wave frequencies.³⁵ As a commander, if employing this weapon system, it is essential to understand the differences between microwave and millimeter waves. Misunderstanding of this concept carries with it a negative connotation that can adversely affect the outcome of a mission even before friendly forces cross the line of departure. A conventional microwave

operates on a frequency of 2.5 GHz; this frequency has a penetration depth of approximately 4.7 inches, hence the reason it was chosen for cooking.

Conversely, ADS operates on a much higher frequency of 95 GHz, and penetrates to a depth of approximately 1/64th inch—equivalent to the thickness of three sheets of paper.³⁶ This is one of the many reasons why this frequency was chosen to be utilized in this weapon system—due to the shallow penetration the effects of the RF energy only affect the superficial layers of the skin, resulting in an intense heating sensation that quickly goes away once the individual is out of the path of the beam.

Well over twenty five years³⁷ of health effects research and testing have been conducted to prove that exposure to the RF energy ADS produces not only complies with the definition of NLWs but most importantly does not create any long-term health effects. To date, there have been over 15,000 documented engagements/exposures that took place in both a well-controlled laboratory environment and in conditions similar to those that would be encountered operationally. Less than 0.15% of those exposed received 2nd-degree burns. These injuries occurred during the fledgling stages of the development and were a direct result of negligent use by untrained operators. Since then, engineering controls both in hardware and software were added to the system to reduce the likelihood of overexposure.

Over the years JNLWD has hosted various Joint Military Utility Assessments and demonstrations to assess the effectiveness of ADS under operational conditions. It was the astounding results, overwhelming success, and potential benefits on the battlefield that influenced senior leaders to continue investing in the development of the technology. The system went from a laboratory test model (ADS-0) to an Advanced Concept Technology Demonstrator

(ADS-1) to a fully ruggedized deployable unit (ADS-2) in a relatively short period of time considering the complexity of the system.

ADS on the Battlefield

"New conditions require...new and imaginative methods.

Wars are never won in the past." General Douglas MacArthur

Military operations never cease when combat operations conclude. In retrospect, it is the point where a nation could be drawn into a lengthy recovery due to the actions of commanders during combat operations. Successful conflict termination is often hampered by the ever-changing security environment and complexities of transitioning of military control to civil authorities. According to William A. Flavin,³⁸ the key to successful conflict termination should include: early interagency planning; establishing workable objective, goals, and end states; providing for adequate intelligence and signaling; ensuring unity of effort; harmonizing the civil and military efforts; and establishing the appropriate post-conflict organization.³⁹ With the end state in mind, a system such as ADS has the potential to ensure the tactical objectives and goals are being attained while reducing the likelihood of collateral damages to personnel and infrastructure that could hinder post-conflict operations.

Consider the following vignette: Coalition forces were conducting patrolling operations (on foot or mechanized) in their assigned area of responsibility—similar to that of the urban centers of Iraq or Afghanistan. As time goes by, the indigenous people are becoming more aggressive towards friendly forces due to altercations. At times there is a need to “move or shove” non-combatants or stop vehicular traffic to allow friendly forces the ability to maneuver without obstruction. What tools are available to members of a typical infantry platoon or squad during this sort of mission to reduce the likelihood of unintentional deaths or injury? During

phase II and III operations, friendly forces are ill-equipped to address this situation appropriately. The force that was used to “move or shove” personnel out of the way may not be appropriate or proportional to the threat due to a lack of options available to the warfighter. This capability gap could, therefore, undermine the efforts of coalition forces in the contested area. What effects does this have on the “hearts and minds” of the local populace, and how could it adversely affect follow on operations?

The ADS could be classified as the “multi-tool” of NLWs; it has proven to be very useful at fixed site security by providing an invisible, instant, and discriminate means to remove an individual or group from an area. In the case of operations in Iraq and Afghanistan, it was well suited for area denial activities within the vicinity of well-established or forward operating bases. The optical camera also extended the visual range of the watchstanders or operators, thereby increasing their situational awareness and ability to make a life-changing decision within the confines of an armored operator’s station. On 22 April 2008, a suicide bomber detonated a vehicle-borne improvised explosive device (VBIED) at the main gate to Joint Security Station Nasser in Ramadi, Iraq. The two Marines who were standing guard at the time were killed in the blast. The entrance was considered to be one of the base’s most dangerous due to being able to be approached from a busy thoroughfare.⁴⁰ Could the use of a directed energy weapon system such as ADS or the RF vehicle stopper in conjunction with lethal force have saved the lives of those two Marines at this base as it provided an option to determine intent at ranges well beyond the blast radius of the VBIED?

What if this technology was available to tactical maneuver units; how could the dynamics of the battlefield be changed? As mentioned earlier, maneuver elements lacked sufficient capability to deal with large groups of indigenous personnel while on the move. A directed

energy weapon system such as ADS can be used to deliver non-lethal effects to change the behavior of non-compliant personnel at ranges well beyond the reach of traditional NLWs.

ADS is not only effective on land, but it is also effective at engaging targets in a maritime environment. During the early stages of operational test and evaluations, a shore-based ADS was used to evaluate the effectiveness of a directed energy weapon against small vessels in Maritime Security Operations. The assessment proved that ADS was effective at delivering non-lethal effects over long distances, and was able to affect the behavior of the boat operators. In September 2014, ADS was again evaluated in a maritime environment. This time it was embarked onboard a United States Army watercraft. The purpose was to assess the effectiveness of ADS from a moving vessel against another moving vessel. As expected, the results were positive. The non-lethal effects that were produced were sufficient to compel the boat's operator to change their behaviors and take alternative action.

The use of ADS in this manner not only provides friendly forces the space needed to maneuver but also the ability to safeguard the lives of non-combatants. Commanders must always be mindful of those tactical victories that contribute to strategic defeats. They must provide their warfighters with the equipment and training that accomplishes the mission, protect the force, and reduce/eliminate collateral damages in order to set the conditions for a smooth and speedy transition from combat operations to establishing self-governance. There is no other NLW in the DOD's inventory that provides the versatility that is needed to preserve human life, be it friendly forces or innocent non-combatants.

Apprehensions to ADS

There is something to be said about utilizing directed energy weapon systems against human targets. As with all NLWs, there is the potential for unintended consequences to occur if

used in a manner not consistent with approved TTPs. Any weapon system(s) developed for use by the United States military must go through a comprehensive legal review process to ensure compliance with the laws of armed conflict. ADS is no different; it complies with all domestic and international laws that apply to new weapons. The legal review found that when used as intended, ADS causes no unnecessary suffering to the targeted individual.

In addition to the extensive legal review, the Directed Energy Bio-effects Division of the Army Research Lab, Human Effectiveness Directorate at Brooks City-Base, San Antonio, TX have thoroughly examined the health effects of millimeter wave on human subjects. After an exhaustive study that spanned more than twenty-five years, there have been no indications that exposure to the millimeter waves of ADS will result in cancer, affect the reproductive organ, or adversely affect the eyes and other vital organs.⁴¹

In 2010, ADS-2 was deployed to Afghanistan but was never used operationally. Why was such a weapon system that only years earlier received high marks during operational evaluations brought into a combat zone and not used? Could it be the task force commander was running a very high profile war and was not ready to entertain an experiment that was pushed onto him by the Pentagon or was he concerned with the perception of using a directed energy weapons system against Afghan civilians? With the latter being the case, ADS was redeployed because there were concerns about how its use against Afghans might be perceived.⁴²

The International Security Assistance Force (ISAF) Commander, General Stanley McChrystal's decision to not utilize ADS in 2010 can be considered a tactical blunder with strategic implications that resonate still to this day. His decision even contradicted with elements of his directive. General McChrystal stated that “we will not win based on the number of Taliban we kill, but instead on our ability to separate the insurgents from the center of gravity (COG)—

the people.”⁴³ If the people are considered to be the COG, and a weapons system is designed to protect these individuals while allowing friendly forces the ability to carry out their assigned mission, why was the ADS not authorized to be used in the Central Command’s AOR to support combat troops? Other elements in the directive identify the need for NLWs, specifically weapon systems with the same capabilities as ADS. When the strategic goal is to defeat the insurgency (End) that is threatening the stability of a nation, how do military units achieve the support of the local populace when the coalition forces who are there to protect them are causing harm to them as well? The United States possesses the technological capabilities (Means) and tactical knowledge (Ways) to employ such weapon systems in a manner that will reduce the toll of human suffering, thereby achieving strategic objectives, but there is still apprehension by commanders to utilize the system operationally.

In addition to the strategic communication hurdles that commanders must overcome if/when utilizing a highly controversial weapon system such as ADS, there is also a lack of policy support from the highest levels in the DOD. The Under Secretary of Defense for Policy (USD (P)) established a comprehensive review and approval process to ensure the responsible use of directed energy weapon systems, and that every effort will be made to safeguard human subjects from the effects of these systems. The Under Secretary explicitly states that directed energy systems that are intended to cause significant injury or death are not authorized for use against human subjects (both combatants and non-combatants).⁴⁴

The same parallel can be drawn between ADS and RCAs, and the regulations that govern their use. RCAs were included in the chemical weapons convention thus creating many layers of bureaucracy for it to be used operationally. The USD (P) accurately captures the classification of ADS. However, this overarching classification has created an extreme burden for those wanting

to utilize the system operationally. Anyone who wishes to use ADS outside the of scope of a demonstration or assessment must request approval from the Chairman of the Joint Chiefs, gain the necessary legal reviews, develop concepts of employment, establish ROEs, identify any potential collateral damage and human effects, proposed communication strategy, and any other information the chairman deems necessary.⁴⁵ This process is somewhat convoluted and redundant. All of the previously mentioned requirements have been complied with, and ADS has been found by competent authority to comply with the principles of proportionality, discrimination, and the avoidance of unnecessary suffering—the tenets of a legal weapon system.⁴⁶

An Alternative Perspective

The United States military needs to be ready for operations across the globe; those operations sometimes claim the lives of innocent civilians. History has shown that civilian casualties are a part of war, especially when the conflict approaches total war.⁴⁷ When a nation decides to engage in hostilities against another, the aggressor is ultimately placing innocent civilians in harm's way. In the western world, modern-day warfare is fought under the Just war theory-Jus ad Bellum, the right to go to war or the morality of going to war and Jus in Bello, the right conduct in or the moral conduct during war.⁴⁸ If war is justified and conducted in a morally acceptable manner, then warring nations will accept the fact that there will be civilian casualties.

The 2018 National Defense Strategy identifies three strategic approaches, one of which is to build a more lethal force.⁴⁹ There is no arguing that the United States military must maintain the competitive edge over an adversary or competitors. To do so, significant investments in research and development, procurement, sustaining, and training are needed to increase the lethality and effectiveness of the forces. In a fiscally constrained environment, anything that does

not increase the lethality of the warfighter should not be a priority for investments. The argument that currently fielded NLWs are sufficient since they will be utilized mainly during phase IV (stability) and V (enable/transition to civil authority) operations is correct if the status quo remains.

The simple fact remains true; commanders must guard against becoming so focused on increasing lethality of their forces that they don't allow time for preparing for operations across the entire spectrum. Additionally, many units are inundated with a robust pre-deployment training regime before deploying. If it is known in advance that operations, while deployed, are going to be conducted during phases II and III, the commander will focus his training efforts on systems that are designed to give him/her the asymmetric advantage (increased lethality) to destroy the enemy. It is much easier for the United States to get into a fight than to get out of one. This inability to terminate a conflict sometimes lies with how operations were conducted before the transition.

The need to invest in a highly sophisticated directed energy weapon system such as ADS is now. These systems would provide the commander and his forces the asymmetric advantage that not only achieves tactical victories, but that will also help set the conditions when the time is right for a transition to civil authority. Considering the incident that occurred at the Joint Security Station, Nasser on 2008—in retrospect this is an example of how the integration of effective non-lethal fires could have increased the effectiveness of the lethal fires and saved the lives of the two Marine sentries.

Conclusion

"If in order to kill the enemy you have to kill an innocent, don't take the shot. Don't create more enemies than you take out by some immoral act." –General James Mattis.

As today's leader in the global arena, the United States calls upon its military to protect its vital interest and allies from those seeking to do harm and challenge the democratic values we hold dearly. When nations elect to exercise the military option, the human toll of war can be staggering. Military planners seldom seek a protracted war; instead, they opt for quick, decisive engagements. However, this is rarely the case, as seen in modern conflicts where coalition forces remain in the country long after combat operations have concluded. One of the many reasons for the lengthy rebuilding period is dealing with the civil unrest that follows phase III operations resulting from the collateral damages and establishing trust with the local populace.

If there is a way to reduce collateral damage and civilian casualties during phase II and III operations, why would commanders not utilize it? Conventional NLWs are extremely limited in range and effectiveness. Advancements and subsequent incorporation of a directed energy counter personnel or materiel NLW system in operations across the entire spectrum of conflict, not just fixed site security or other police type operations would prove its efficacy on the battlefield. When employed smartly, systems such as ADS can and will extend the operational reach of a commander by providing him/her with a scalable, long range non-lethal option. This option will create the decision space necessary for him/her to properly evaluate the situation to determine which course of action to take next.

Before directed energy NLWs can become part of the DOD's inventory, stakeholders must first overcome many obstacles. One of which is combating the misinformation regarding the capability and effects of counter personnel directed energy NLWs. To do so, the

implementation of a robust communication strategy plan early in the shaping phase could help combat adversary propaganda regarding directed energy NLWs. Another obstacle that needs to be addressed is when commanders and senior civilian policymakers are reluctant to use or authorize counter personnel directed energy NLWs because they don't truly understand the technology. Gaining policy support from the highest level within the DOD would allow tactical units the freedom to use systems such as ADS operationally. At the time of this writing, the DOD requires commanders to comply with a very convoluted review and approval process if they [commanders] had a desire to use ADS or similar devices operationally. Removing counter personnel, directed energy NLWs from under the umbrella of all directed energy weapons, and incorporate it under the current policy for NLWs would alleviate this policy issue.

It is imperative that senior leaders understand the utility of a directed energy NLWs, and continue to support the advancement of the technology. When conducting missions that require a maneuver element to neutralize, defeat, fix, block, canalize, contain, etc. an enemy, directed energy NLWs are well suited and will enhance the unit's ability to achieve its mission while potentially reducing civilian casualties and collateral damage. For example, ADS can be used to separate combatants from non-combatants or move combatants to a position that supports better geometry of fire for lethal engagements.

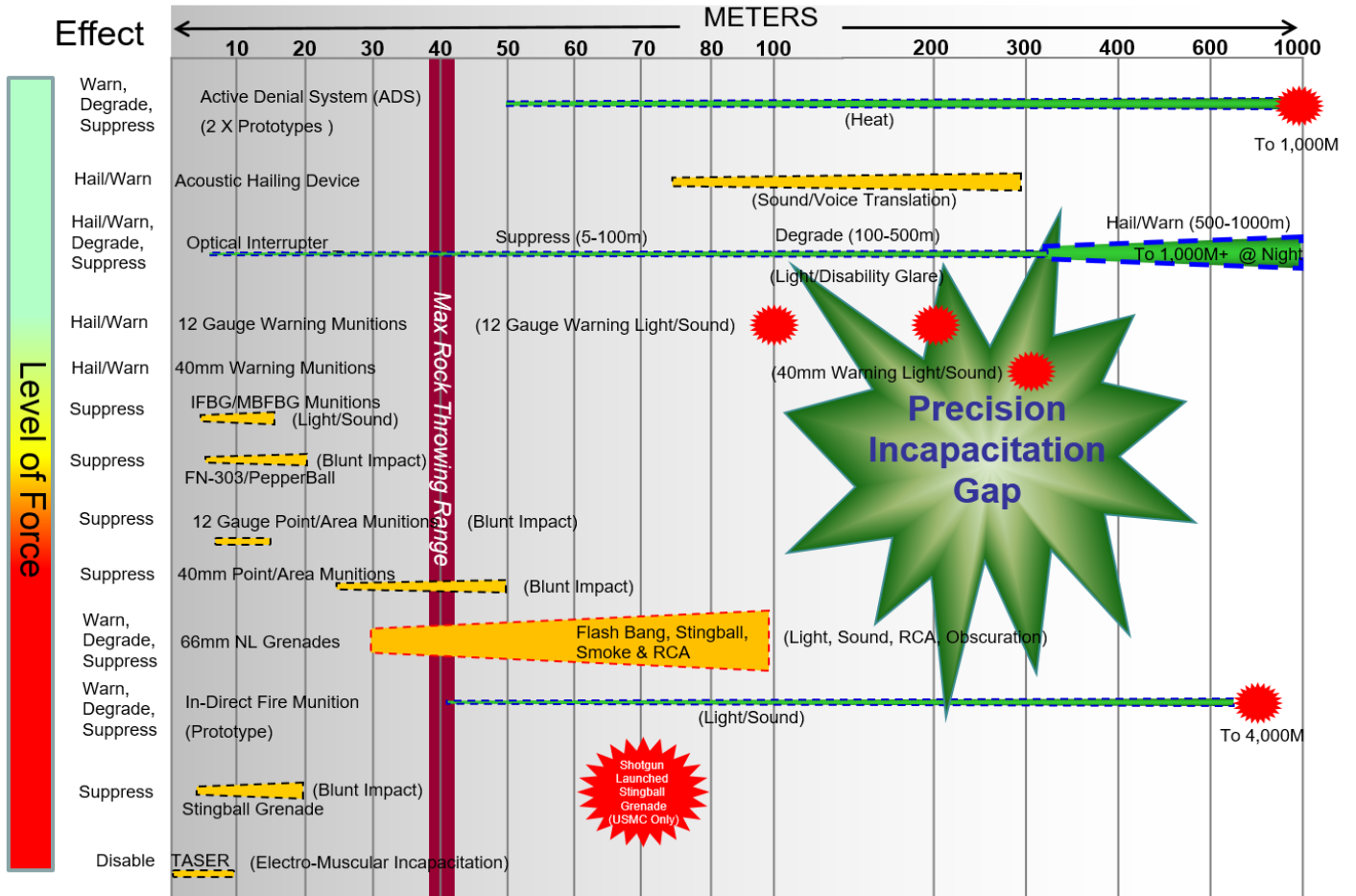
Directed energy systems are not only reserved for counter personnel uses; the technology has demonstrated that it can be useful in stopping vehicles and vessels. But only with continued investments will these proof of concept models be advanced to valuable military equipment that will provide a commander additional options to maintain momentum, speed, agility, and combat power while reducing the likelihood of collateral damage. As the technology matures, these

systems will become smaller, less complicated, and more intuitive, thereby increasing their effectiveness in an operational environment.

The adage “the most dangerous weapon is the six inches between your ears” is frequently used in conversations regarding the use of force. Educated service members are more effective in addressing ambiguous situations than those who are not. It is just as crucial for the institution to invest in educating the force as is advancing NLWs technology. The JNLWD must continue its efforts to inform Officers and Non-Commissioned Officers (NCO) during resident Professional Military Education or other formal courses about the utility of NLWs across the entire spectrum of warfare. There is also a heavy burden placed on the young warfighter during the conduct of military operations. NCOs should not have to shoulder responsibilities that could have strategic implications because they were not trained or appropriately equipped. The wrong decision at the tactical level could have a profound impact on the strategic and operational objectives.

When diplomacy fails, and military action is required to achieve the political objective, the application of force can and will be questioned. NLWs provide a more discriminate and controlled option for the use of force. Advance NLWs play a vital role during all phases of military operations by allowing commanders the ability to set more favorable conditions to transition to phase IV and V operations.

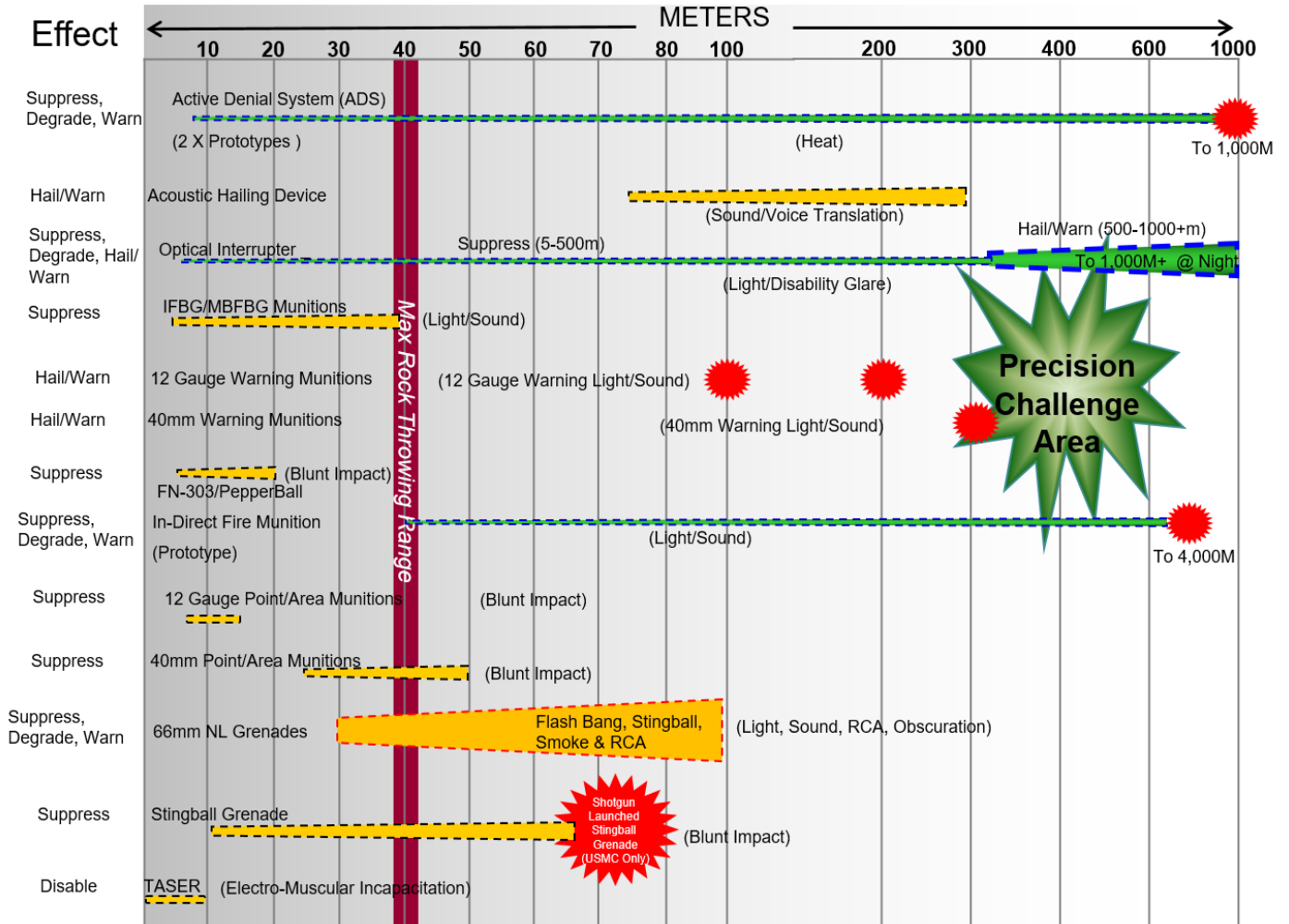
JNLWD NL Weapons Range/Effects Overview



Non-Lethal Weapons in relation to the Precision Incapacitation Gap
 Source: Provided by Joint Non-Lethal Weapons Directorate, Quantico, VA

Appendix

JNLWD NL Weapons Range/Effects Overview



Non-Lethal Weapons in relation to the Precision Challenge Area
 Source: Provided by Joint Non-Lethal Weapons Directorate, Quantico, VA

Endnotes

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⁴ IBID, 7.

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¹⁹ Joint Non-Lethal Effects, Capabilities Based Assessment, Functional Solution Analysis, December 2008 (FOUO). Obtained from JNLWD.

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²² US Department of Defense, *DOD Executive Agent for Non-Lethal Weapons (NLW), and NLW Policy*, Directive 3000.03E, August 31, 2018, 12.

²³ There are traditionally three levels of maintenance, the first being the Organizational level—at this level operating units perform routine maintenance such as inspections, servicing, minor repairs, and preventative maintenance. The second is the Intermediate level—this level supports the organizational level by providing a greater of maintenance for a major end item. Finally, the third is the Depot level of maintenance—it is at this level major repairs or overhauls are conducted on the major end item or individual components.

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