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**The Joint Warfighting Center
Joint Doctrine Series**

Pamphlet 2



***Doctrinal Implications of
Low Collateral Damage
Capabilities***

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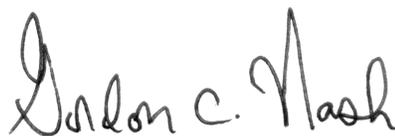
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Preface

This USJFCOM Joint Warfighting Center (JWFC) pamphlet, ***Doctrinal Implications of Low Collateral Damage Capabilities***, supports the intent and purpose of USJFCOM JWFC Pam 1, *Pamphlet for Future Joint Operations (PFJO)*, 1 March 2002. This pamphlet is part of a “**Joint Doctrine Series**” intended to facilitate changes to joint doctrine based on the good ideas and other results that emerge from the Joint Concept Development and Experimentation (JCDE) Program and related joint experiments such as **MILLENNIUM CHALLENGE 2002 (MC 02)**. The primary purpose of **JWFC Doctrine Pam 2** is to raise awareness, promote debate, and discuss doctrinal implications associated with “low collateral damage capabilities” (LCDC), a new term that encompasses nonlethal weapons for the purpose of this discussion.

Legal and moral considerations surround the issue of collateral damage and drive rules of engagement that often complicate the joint force commander’s (JFC) primary task—mission accomplishment. Limiting collateral damage is a planning factor mentioned in several joint doctrine publications. But is current joint doctrine sufficient in the treatment of this factor? How should the JFC consider planning for and employing LCDC in the context of operational net assessment, effects-based operations, and other concepts examined in MC 02 and other events? With continuing advancements in precision engagement and nonlethal technologies for military application, should the joint community develop more comprehensive doctrine focused on the LCDC topic? While many current LCDC can be applied at the tactical level, can a full package of these capabilities change the way a JFC plans to achieve the theater campaign’s operational and strategic objectives? This pamphlet begins to address these issues with the intent of stimulating discussion throughout the joint community.

We welcome your comments and ideas on this important topic. Point of contact for JWFC Doctrine Pam 2 is Mr. Rick Rowlett, JW2114, 757-686-6167 (DSN 668), rowlettr@jwfc.jfcom.mil.



GORDON C. NASH
Major General, U.S. Marine Corps
Commander, Joint Warfighting Center
Director, Joint Training, J-7

"Today, world events mandate a need to project non-lethal force across all levels of war to enable our warfighters and leaders to effectively deal with a host of traditional as well as non-traditional threats. Now more than ever, the minimal level of public tolerance for collateral damage and loss of human life, coupled with the tendency for the typical adversary to exploit our rules of engagement to his benefit, necessitates an effective and flexible application of force through non-lethal weapons."

James L. Jones
General, USMC

**32nd Commandant of the Marine Corps and former
DOD Executive Agent for the Joint Non-lethal Weapons Program**

Table of Contents

Section I — Background	1
• Introduction.....	1
• Key Terms and Relationships.....	2
• Joint Experimentation on Low Collateral Damage Weapons.....	3
 Section II — Low Collateral Damage Capabilities -- Ways and Means... ..	6
 Section III — Operational Implications of LCDC.....	8
• Employment Considerations.....	8
• Employment Perspectives.....	9
• Employment Examples.....	11
 Section IV — Doctrinal Implications of LCDC.....	15
• Current Doctrine Summary.....	15
• Perspectives.....	16
• Conclusions.....	17
 Appendix A — Examples of Actual and Potential LCDC Technologies and Systems	A-1
 Glossary.....	GL-1

Section I — Background

Introduction

Collateral damage has long been a consideration in military operations. The DOD dictionary defines the term as—

“Unintentional or incidental injury or damage to persons or objects that would not be lawful military targets in the circumstances ruling at the time. Such damage is not unlawful so long as it is not excessive in light of the overall military advantage anticipated from the attack.”¹

This definition provides flexibility for the commander to attack high-value targets even when collateral damage is likely, but it also serves warning that there can be legal consequences for indiscriminate attacks that fail to consider this important factor. The potential for collateral damage often contributes to restrictive rules of engagement (ROE), particularly early in an operation.

Traditional methods for limiting collateral damage include carefully devised ROE; thorough intelligence operations to identify the intended targets correctly; careful planning to strike only the targets that provide the desired effects; sophisticated tools and methods that help planners estimate both the amount and pattern of collateral damage caused by a wide array of weapons; mitigation techniques; and use of precision-guided munitions to increase the probability of hitting the intended targets. **Emerging methods** for limiting collateral damage include use of nonlethal capabilities that, by their nature, are generally nondestructive (from an “explosive” perspective) as well. Activities in the nonlethal arena include publication of

Contents	
Section I:	Background
Section II:	LCDC Ways and Means
Section III:	Operational Implications
Section IV:	Doctrinal Implications
Appendix A:	LCDC Technologies and Systems
Glossary	

¹ Joint Publication (JP) 1-02, *Department of Defense Dictionary of Military and Associated Terms*, 12 April 2001 as amended electronically through 25 Sep 2002.

a DOD directive on nonlethal weapons;² implementation of a DOD Non-lethal Weapons Program administered by a Joint Non-lethal Weapons Directorate (JNLWD); significant research and experimentation by DOD and national laboratories;³ development of a related joint concept;⁴ and recent joint experiments conducted by the Joint Experimentation Directorate (J-9) in US Joint Forces Command (USJFCOM).

USJFCOM JWFC Doctrine Pam 2 is intended to facilitate changes to joint doctrine based on the good ideas and other results that emerge from the Joint Concept Development and Experimentation (JCDE) Program and related events such as **Exercise MILLENNIUM CHALLENGE 2002 (MC02)**. **The primary purpose of this pamphlet is to raise awareness, promote debate, and discuss doctrinal implications associated with low collateral damage capabilities.** The stimulus for this topic is conceptualization and experimentation conducted by USJFCOM J-9 on low collateral damage weapons during the early-2000 through mid-2001 period, related issues examined during MC 02, ongoing work by the Joint Non-lethal Weapons Program, and recent discussions on the doctrine implications associated with strategic use of these capabilities.

Key Terms and Relationships

Although most current DOD and national laboratory work is in the “nonlethal weapons” arena, this pamphlet focuses on “**low collateral damage capabilities**,” a term that subsumes nonlethal capabilities for the purpose of this pamphlet. These will include ways and means by which the joint force can limit damage and injury to those objects and personnel, which typically are lawful military targets. Following are terms relevant to this discussion:

- *Nonlethal weapons (NLW)*: Weapon systems that are specifically designed and primarily employed so as to incapacitate personnel or materiel, while minimizing fatalities, permanent injury to personnel, and undesired damage to property and the environment (DOD Directive 3000.3).
- *Low collateral damage weapons (LCDW)*: Those weapon technologies or systems that have the specific capacity to precisely attack an adversary function

² DOD Directive 3000.3, *Policy for Non-Lethal Weapons*, 9 July 1996. This policy established the Joint Nonlethal Weapons Program and designated the Commandant of the Marine Corps as the program’s executive agent.

³ Including DOD Advanced Research Projects Agency (DARPA), Sandia National Laboratory (SNL), and Lawrence Livermore National Laboratory (LLNL).

⁴ Department of the Navy, Joint Non-Lethal Weapons Directorate, *Joint Concept for Non-Lethal Weapons*, 5 January 1998. Headquarters, United States Marine Corps is the Executive Agent for the DOD Non-lethal Weapons Program and the related joint concept.

while minimizing collateral damage and casualties (J-9 Interim Report on NKT and LCDW).⁵

- **Low collateral damage capabilities (LCDC):** Those weapons, technologies, and other capabilities that have the specific capacity to precisely achieve a desired effect on an adversary capability (individual target, system, or function) while minimizing collateral damage and casualties. **LCDC comprises a more extensive set of capabilities than NLW and LCDW and includes information operations capabilities**, which are excluded from NLW by DOD Directive 3000.3⁶ and not considered in the J-9's LCDW experiments. Although not an approved doctrinal term, LCDC could be proposed at some point for future incorporation in joint doctrine.

Joint Experimentation on Low Collateral Damage Weapons

During the period from early 2000 through mid 2001, USJFCOM J-9 examined LCDW in a set of experimentation events using the following LCDW hypothesis:

If a set of existing or developmental non-kinetic technologies could be weaponized as a complement to current kinetic (explosive and penetrating) engagement means, then the joint force could engage critical targets and achieve desired operational effects with acceptable collateral damage.

USJFCOM conducted the events in collaboration with the Joint Non-lethal Weapons Directorate (JNLWD), Sandia National Laboratory, and Lawrence Livermore National Laboratory. Some examples of LCDW considered in the events included—

- a **robotic mini-torpedo** that can swim into a hydro-turbine intake at a dam and detonate inside the flow control valve or turbine, disabling the generator;
- an **electronic bomb** that can be dropped by parachute next to a building or military unit and emits electromagnetic pulse (EMP) to disable the electronic equipment in the area;
- and a system of **micro air vehicles** that swarm an air defense site, home optically on the launchers or guns, and disable them with small precision armor piercing warheads.

⁵ In March 2001, USJFCOM J-9 conducted a limited objective experiment to investigate the potential use of LCDW. The J-9 published an interim report on this experiment on 1 June 2001.

⁶ DOD Directive 3000.3 (footnote 2) excludes any capability not designed **specifically** for the purpose of minimizing fatalities, permanent injury to personnel, and undesired damage to property and the environment, even though these capabilities may have non-lethal effects.

USJFCOM Experiments

Two events—an analytically based limited objective experiment (LOE) and a leveraged event (US Southern Command's Exercise UNIFIED ENDEAVOR 01-3)—were designed to address some important warfighting challenges related to LCDW. The **first challenge** investigated LCDW that could enable the joint force to engage critical targets with collateral damage that is acceptable within constraining ROE. A **second challenge** concerned the ability of the joint force to shape the battlespace dynamically (using LCDW to impede the adversary while not interfering with friendly operations) and achieve operational- and strategic-level effects rather than just tactical application. **The second challenge is the focus of this pam.** Four key concept elements, highlighted in the accompanying box, provided the basis for the events.

LCDW Concept Elements

1. The use of nonkinetic engagement means such as directed energy systems, immobilizing systems, and fuel contaminants, and aerosols.
2. Delivery means including manned and unmanned platforms, ground and air delivery, and long-range precision fire systems.
3. Experimental modification of current doctrine such as JP 3-60 (*Joint Doctrine for Targeting*) to include processes for LCDW target selection, means selection, and delivery.
4. An effects-based battle damage assessment process.

The **first event**, the LOE conducted in January 2000, investigated LCDW in a number of vignettes that could have operational-level implications. These included denial to the adversary of bridges, roads, and airports; disablement of hydroelectric power plants, thermal/diesel power stations, ships, and surface-to-air missile sites; destruction of air defense systems; and immobilization of locomotives. Some vignettes focused on using a single type of weapon—for example, attacking the generator penstock (the entry to the flow control valve) in a hydroelectric power plant with torpedo-like “smart fish” weapons, which contain only enough explosive or abrasive to disable the flow control valves or unbalance the generator turbines. If executed correctly, this attack would disable the power plant and disrupt the power grid (the desired effect) with much lower collateral damage than an attack with conventional weapons.

Other vignettes used packages of LCDW capabilities to achieve desired effects. For example, bridge denial operations combined malodorants to encourage personnel to vacate the bridge area; seismic and acoustic unattended ground sensors to detect and identify adversary vehicles; a foam-dispensing system with embedded sub-munitions to provide a barrier to traffic on the bridge; and a number of small robotic vehicles armed with various lethal and nonlethal weapons to defend the barrier and sensor sub-systems. In the experiment, the net effect of this bridge-denial package of LCDW capabilities kept the adversary from using the bridge, but preserved it for later use by friendly forces.

The investigation in the **second event**, UNIFIED ENDEAVOR 01-3 (March 2001), focused on decision-making regarding use of LCDW rather than traditional weapons. During the targeting process, planners considered how to use LCDW for five tasks: denying the adversary use of a bridge; stopping power production; denying use of key road, rail, and water transportation arteries; disabling a C4I node; and destroying adversary air defense.

The Results

In the first event, J-9 examined the effectiveness of LCDW using the Joint Combat and Tactical Simulation (JCATS) model. Assessment of experiment results concluded that the LCDW modeled and employed were at least as effective as traditional systems in creating target effects required by the joint force. Figure 1 summarizes that exclusive use of nonkinetic technology (NKT) capabilities significantly reduced the dollar cost of collateral damage and eliminated civilian casualties in this scenario. Moreover, the use of LCDW in this event actually resulted in a reduced number of required sorties than would be expected using traditional weapons alone. The results of the second event, UNIFIED ENDEAVOR, were not as conclusive, but demonstrated that there are several decision-making considerations regarding selection of LCDW during the targeting process. The doctrinal, training, and leader development implications associated with future fielding of these weapons are worth exploring.

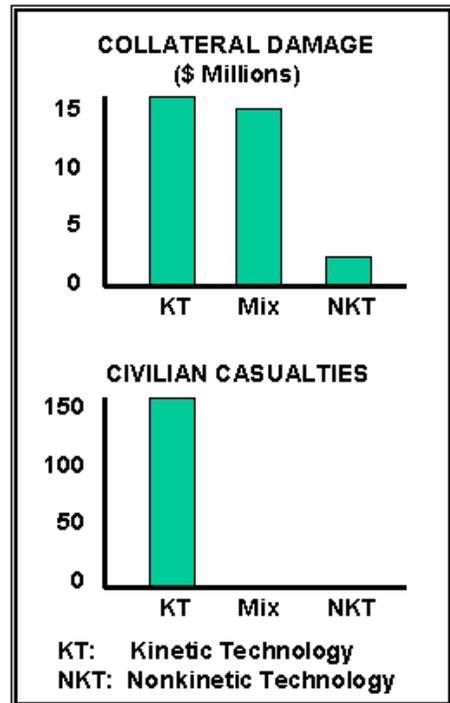


Figure 1: Event Results

Section II — Low Collateral Damage Capabilities – Ways and Means

"As we step forward into the 21st century, we must look for new opportunities to leverage developing and emerging technologies that enable warfighting commanders to capitalize on the full spectrum of nonlethal capabilities. The value added will best be realized when we ensure that technology, operations, and policy are in balance, and the education of the American leadership, warfighters, and public is complete. These capabilities must become part of our daily lexicon."

E. R. Bedard
Lieutenant General, USMC
Chairman, DOD Joint Non-lethal Weapons
Program Integrated Product Team

Nonlethal weapons are generally grouped in the following categories:

- **Electromagnetic:** such as radio frequency devices; high-power microwave and millimeter wave; infrared lasers; visible light lasers; ultraviolet lasers.
- **Mechanical:** such as blunt impact devices, barriers, and entanglements.
- **Acoustic:** such as audible and ultrasound.
- **Chemical:** such as riot control agents, foams, reactants, anti-traction agents, and malodorants.
- **Ancillary:** such as markers and encapsulants.

NLW Core Capabilities

Counterpersonnel

- *Control crowds*
- *Incapacitate individuals*
- *Deny areas to personnel*
- *Clear facilities and areas*

Countermateriel

- *Deny land, sea, air, and space to vehicles*
- *Disable or neutralize vehicles, vessels, aircraft, and equipment*

The accompanying box shows the core capabilities of NLW.⁷ Also, “**countercapability**” (disabling or neutralizing the adversary’s facilities, systems, and

⁷ Taken from the *Joint Concept for Non-lethal Weapons*.

weapons of mass destruction) has been described as complementary to the two core capabilities.⁸

Most nonlethal capabilities in the categories listed above are effective at the tactical level, particularly against non-military elements in situations with restrictive ROE, such as crowd control during a humanitarian assistance operation. Some capabilities, such as long-range lasers mounted on various platforms, could engage specific air, sea, and land targets with great precision. The effects achieved by successful engagement against targets the joint force commander (JFC) designates as critical, like WMD-capable mobile missile launchers, could be considered operational or strategic in nature. In these cases, however, the JFC must determine if the importance of the target would outweigh collateral damage considerations.

As mentioned in Section I, LCDC encompass a broader set of capabilities than either NLW or LCDW, in large part by adding offensive information operations (IO). **Offensive IO threaten, saturate, exploit, disable, jam, misinform, deceive, deter, compel, influence, and destroy the adversary's information and related capabilities.** They can achieve desired direct and indirect effects with no collateral damage.⁹ For example, computer network attack (CNA) can disable or neutralize an adversary's C4I systems using computer viruses, worms, and other methods that affect only the targeted systems. Effectively executed IO, such as CNA and deception operations, can be unrecognizable to the adversary as an attack or attempt to influence the decision maker. Some offensive IO can engage some adversary systems from well outside the actual or potential joint operations area (including from CONUS). Finally, some offensive IO can be used very early in a crisis, potentially limiting escalation. Refer to Appendix A for examples of actual and potential LCDC technologies and systems that affect personnel and materiel.

"The joint force commander will conduct information operations whether facing an adversary during a conflict or engaged in humanitarian relief operations. Such operations will be synchronized with those of multinational and interagency partners as the situation dictates. New offensive capabilities such as computer network attack techniques are evolving. . . . The continuing evolution of information operations and the global information environment holds two significant implications. First, operations within the information domain will become as important as those conducted in the domains of sea, land, air, and space. . . . Second, there is significant potential for asymmetric engagements in the information domain.

Joint Vision 2020

⁸ National Defense University publication *Defense Horizons Number 9*, "Nonlethal Capabilities: Realizing the Opportunities", by LtGen E. R. Bedard. March 2002.

⁹ There are exceptions that commanders and planners must consider. For example, disabling the computers that control power plant operations in order to shut down an urban power grid could affect people on life support systems in hospitals and other institutions. Also, some offensive IO involve attacking a target with conventional munitions with attendant collateral damage.

Section III — Operational Implications of LCDC

Employment Considerations

There is little question that low collateral damage capabilities provide the joint force a valuable set of tools for a variety of missions, particularly when the use of lethal means violates established ROE or is otherwise unacceptable to the JFC. If used effectively, LCDC can contribute to mission accomplishment and—

- Limit destruction
- Reduce fratricide
- Limit civilian casualties
- Limit conflict escalation
- Enhance force protection
- Limit reconstruction costs
- Accommodate public expectations
- Provide employment options earlier in a crisis
- Leverage our advantage in advanced technologies
- Push employment decision authority to lower levels
- Provide a greater range of graduated-response options for leaders
- Provide a greater range of potential effects against systems and functions
- Reduce value of some adversary techniques, like hiding among the innocent

"Traditional military weapons require commanders to make difficult "trade off" decisions regarding the proper balance between mission accomplishment, force protection, and the safety of noncombatants. Non-lethal weapons expand the number of options available to commanders confronting situations in which the use of deadly force poses problems."

**A Joint Concept for Non-Lethal Weapons
Joint Non-Lethal Warfare Directorate
5 January 1998**

Against these significant advantages, commanders and planners also must consider a number of other planning considerations:

- Risk
- Media understanding of LCDC
- Limited duration of some LCDC effects
- Ways and means to accurately assess effects
- Creating the best employment balance with traditional capabilities
- Possibility of promoting a public perception of "zero-casualty" warfare
- Treaty and legal restrictions (particularly in the area of chemical-like effects)

Employment Perspectives

The *Joint Concept for Non-Lethal Weapons* (footnote 4) is an excellent reference that provides a set of **guiding principles** for NLW and discusses their **core capabilities**. It also provides scenarios that illustrate the use of NLW in various hypothetical situations. With minor modifications, these principles, core capabilities, and scenarios could easily accommodate the broader LCDC category. Section II mentioned the NLW core capabilities. The accompanying box lists the guiding principles.

NLW Guiding Principles

- Leverage high technology
- Enhance operations
- Augment deadly force
- Provide “rheostatic” capability
- Focus on multi-level application
- Facilitate expeditionary operations
- Maintain policy acceptability
- Provide reversibility in counterpersonnel effects
- Apply across the range of military operations

Nonlethal capability typically is considered an adjunct to traditional military combat capability. In the principle **augment deadly force**, for example, the *Joint Concept for Non-lethal Weapons* states—

“The existence of non-lethal capabilities therefore does not represent the potential for ‘non-lethal warfare’ or ‘non-lethal operations.’ Unrealistic expectations to that effect must be rigorously avoided. Noncombatant casualties, to include serious injuries and fatalities, will continue to be a regrettable but unavoidable outcome when military power is employed, whether or not non-lethal weapons are available.”

However, in a 2001 *Joint Forces Quarterly* article on nonlethal weapons, US Army War College professor Stephen Metz took a somewhat different view. He wrote—

*“Moreover, this second revolution must be based on minimum destruction since the theater will often be an urban environment crowded with noncombatants. The enemy may need to be restrained rather than killed. **Non-lethality will thus be a defining characteristic of the second revolution in military affairs rather than a peripheral one as it is in Joint Vision 2020.**”¹⁰ (emphasis added)*

Clearly the commander must continue to balance the use of lethal force with nonlethal capabilities from situation to situation. Steven Metz seems to suggest that the typical balance can (and should) shift in the direction of nonlethal options to accommodate the nature of future conflict, perhaps even in those situations in which we would traditionally engage the adversary with destructive ways and means. The broader LCDC category of capabilities helps enable this shift by adding the low

¹⁰ Steven Metz, “Non-Lethal Weapons—A Progress Report,” National Defense University publication *Joint Forces Quarterly*, Spring/Summer 2001, pp 18-22.

collateral damage characteristics of information operations as described in Section II. **This is not to say that our personnel would ever be denied the inherent right of self-defense with deadly force or that the commander would have to forfeit the mission in favor of lower collateral damage.**

Employment of LCDC at the tactical level (in operations such as crowd control) is fairly well defined. For example, under the charter of the Joint Nonlethal Weapons program (JNLWP), the Marine Corps has identified a number of nonlethal components that comprise a nonlethal weapons capability set. Many of these components are currently fielded (such as riot batons, bean-bag rounds, sting-ball rounds, blunt-impact munitions, and diversionary devices) and others in the NLW set are under development. The *Joint Concept for Non-lethal Weapons*—published to provide an intellectual framework for JNLWP research, development, acquisition, and doctrine—provides several hypothetical scenarios for tactical use of emerging NLW capabilities that help visualize employment options. There is also a multi-Service publication that describes NLW employment procedures.¹¹

This progress notwithstanding, **our country and military will continue to be challenged with employing forces designed, organized, and trained for combat operations in missions that demand restraint and perseverance** such as foreign humanitarian assistance and DOD support to counterdrug operations. Therefore, development of a wider range of LCDC will increase the JFC's flexibility when considering potential courses of action.

LCDC availability should never keep the commander from using the best combination of all available capabilities to achieve the effects required for mission accomplishment, given the ROE at the time.

Most LCDC currently developed are principally for tactical application in MOOTW missions. However, the pursuit of capabilities applicable **across the range of military operations and levels of war** is consistent with goals and objectives in the June 2000 *Joint Nonlethal Weapons Program Master Plan*.¹² Employment of LCDC at the operational level in higher-intensity combat operations is more problematic than tactical employment. An obstacle to the broader use of LCDC in these circumstances is our current lack of a fielded family of low collateral damage systems and consideration of how to employ them in packages or sets of complementary capabilities that can substitute for destructive ways and means. USJFCOM's experiments (described in Section I) addressed LCDC actions to achieve operational-level effects, such as denial of a major transportation artery to an adversary while protecting it for later use by the joint force.

¹¹ FM 90-40 (Army); MCRP 3-15.8 (Marine Corps); NWP 3-07.31 (Navy); USCG Pub 3-07.31 (Coast Guard). *Multiservice Procedures for the Tactical Employment of Nonlethal Weapons*, October 1998.

¹² Page 8, Objectives 4.2.1 and 4.2.2. The Master Plan is a product of the Joint NLW Product Team.

Another relevant reference that examined related issues is the *Non-Lethal Weapons Policy Study*¹³ conducted in 1998 by the Center for Strategic and International Studies for the Office of the Under Secretary of Defense for Policy. The study's purpose was to explore the need for a national policy on nonlethal weapons. The study's emphasis was on long-range, large-scale weaponization of nonlethal technologies for possible use as instruments of national policy. The study's members included a Military Options Panel, comprised of uniformed military officers from all Services. This panel examined the potential use of NLW to achieve operational and strategic effects in a variety of scenarios. The study found that, if implemented correctly, weapons based on nonlethal technologies could be employed in an operationally feasible and successful manner.

"It is concluded that the capability to conduct strategic applications of non-lethal technologies would be of great political value to the U.S. in deterring aggression, preventing deadly conflict, controlling escalation, enjoying major advantages in battle, bringing conflicts to a favorable conclusion, and establishing regional security arrangements."

**Non-lethal Weapons Policy Study
Final Report, 5 February 1999**

Employment Examples

High-technology LCDC systems have already been used in combat. For example, carbon filament bombs (CBU-114) were used in both the 1990-91 Persian Gulf Conflict and the more recent conflict in Yugoslavia to disable electrical generators and switching yards. Following are additional hypothetical examples of using high-technology LCDC systems against a capable adversary in various target engagements that could achieve operational- or strategic-level effects for the JFC.

- Early in a crisis, the joint force uses computer network attack capabilities to implant a "mole," a "sniffer," and a "virus" in the main computer of the adversary's intelligence-gathering system. The mole provides the joint force with access to unit locations and readiness information; the sniffer identifies all users who log on to the intelligence network; and the virus, programmed to activate on command or at a designated time, severely degrades the main computer's ability to access information from the adversary's intelligence network. Not only does this attack threaten the adversary's capabilities, but it also provides information that could give our senior leaders leverage during ongoing diplomatic negotiations aimed at preventing the crisis from escalating.
- In conjunction with other agencies, the JFC also plans for computer network attack against the adversary's economic and infrastructure elements of national power. Using national capabilities, this attack targets viruses against the

¹³ Final Report published 5 February 1999.

adversary's maritime and highway shipping control systems, causing significant disruption and adverse economic impact. Concurrently, a joint force air component B2 launches an AGM-158 Joint Air-to-Surface Standoff Missile (JASSM) from outside the adversary's area defenses. The JASSM flies a course to a major rail yard where it dispenses "carbon powder bomb" sub-munitions. These blanket the targeted area with highly conductive carbon powder that disables any operating locomotive and other vented electronic equipment. These combined attacks demonstrate our potential to affect the adversary's entire range of political, military, economic, social, infrastructure, and information (PMESII) elements¹⁴ and can be used as a persuasive or coercive element to limit escalation.

- At any time during the joint operation, the JFC might decide to disable infrastructure power sources, such as hydroelectric power plants and thermal/diesel power stations, for either a direct effect on the adversary's military operations or for a psychological effect on the country's leaders and populace. In this scenario, the joint force naval component employs a Joint Strike Fighter with AGM-154 Joint Standoff Weapon (JSOW) against the power plant. The JSOW glides to a point near the power plant's cooling reservoir and dispenses 25 "minnow" sub-munitions. Each of these contains propulsion and guidance systems and a small explosive or expanding foam payload. The minnows navigate to the station's heat exchanger, detonate, and disable power production. Concurrently, a special operations team lands by V-22 in the vicinity of a hydroelectric power plant and places a number of "smart fish" (containing a larger payload than the similar minnows) near the penstock intake grates. The smart fish navigate to the intake grates where they eject their explosive packages into the high flow-rate water stream. These packages are sucked to the generator turbines and detonate near the flow control valve, causing the plant to be shut down for repairs.
- As the crisis escalates, joint force reconnaissance assets locate an important military command and control facility in the country's capital city. Rather than risk significant collateral damage by employing conventional munitions, the JFC decides to use an enhanced non-nuclear electromagnetic pulse (EMP) weapon or other radio-frequency weapon to disable the center's C4I systems. A medium-range unmanned aerial vehicle (UAV) launched from an aircraft carrier delivers the weapon. The enhanced EMP is able to penetrate the typical shielding expected to be on the adversary's electronic systems.
- When intelligence indicates that the adversary is preparing to move ground units from garrison to field battle positions, the JFC decides to interdict these units to provide time for the joint force land component to position forces. Land component planners identify three key bridges that are natural choke points.

¹⁴ The PMESII model is described in the USJFCOM J-9's concept paper, *Operational Net Assessment*. Readers can review the current version of this paper on the USJFCOM J-9 unclassified website (www.je.jfcom.mil). Access the "J-9 Web Portal" and sign up for an account; then enter the "Concept Development" knowledge community and the "Knowledge-C2 Division" in that order.

Rather than destroy them and deny their later use by the joint force, the land component employs three bridge/road denial capability sets. Each set is comprised of packages that contain bridge clearing capabilities, sensors, barriers, and defensive capabilities.

- The “**clearing**” package, delivered by JSOW consists of a mix of flash-bang devices, frangible vials of malodorants, and riot control agents that cause people in the vicinity of the bridge to leave.
- The “**barrier**” package, also delivered by JSOW in this case, consists of foam-dispensing canisters and anti-personnel and anti-vehicle submunitions deployed on the bridge entrances. The canisters dispense sufficient quantities of dense foam that hardens in a short time and covers the submunitions. Attempts to clear the foam will detonate the submunitions.
- The “**sensor**” package consists of a number of tactical unattended ground sensors (TUGS) delivered by JSOW. Each sensor has the capability to identify and provide location information on transient and continuous sources at ranges of greater than 500 meters. Sufficient sensors are deployed to cover a radius of two km from both entrances to the bridge.
- The “**defensive**” package is delivered by guided parafoil air delivery system (GPADS) from a C-130 at a standoff range exceeding 20 miles. The package contains a number of small wheeled and tracked robotic vehicles that are linked to the TUGS. These vehicles carry a mix of anti-personnel and anti-vehicle weapons that can cause a combination of lethal and nonlethal effects.

Precise control over emplacement of the bridge denial packages is accomplished using a medium-altitude UAV, which can also function as a laser designator for additional precision munitions should they be required.

The foregoing examples show how the joint force might employ a variety of LCDC, including offensive IO, to perform various tasks that contribute to mission accomplishment. While the possible benefits of each example are evident, perhaps there is even greater value in considering the **combination of potential effects** if the JFC has a wide array of LCDC at his disposal. **The use of LCDC to achieve operational-level and strategic effects—with attendant advantages and considerations mentioned earlier—could become much more routine in the future.** Nonetheless, LCDC availability should never keep the commander from using the best combination of all available capabilities to achieve the effects required for mission accomplishment, given ROE at the time. Continued concept development and experimentation should help determine the full potential of this critical area.

Effects-based thinking and planning are key to employing LCDC to their full potential. Inherent in the employment of LCDC is the issue of **control**. Although our understanding of weapons effects and our ability to estimate collateral damage

continues to improve, planners must still think through potential unintended second- and third-order effects of LCDC employment. From a USJFCOM joint experimentation perspective, **effects-based planning** begins with **operational net assessment (ONA)**—a continuous and collaborative process that develops a thorough understanding of adversary and friendly capabilities. The goal of ONA is to help decision makers understand the range of actions available to achieve desired effects against the adversary. Collateral damage estimation is an important factor in this process. See the USJFCOM J-9 concept papers on the J-9 website (footnote 14) for more information on effects-based and ONA constructs.

Section IV — Doctrinal Implications

There are potentially significant DOTMLPF¹⁵ implications associated with the comprehensive fielding and employment of operational- and strategic-level LCDC. This section focuses on the question—**Is current joint doctrine sufficient in its treatment of this important issue?**

Current Doctrine Summary

Several joint doctrine publications refer to the use of nonlethal means to attack targets. For example, JP 3-09, *Doctrine for Joint Fire Support*, states—

“Nonlethal fires should be integrated into operations to produce synergistic results. Examples are EW, certain PSYOP, smoke operations, and some command and control warfare (C2W) operations, which deceive the enemy, disable the enemy’s C2 systems, and disrupt operations. The employment of nonlethal fires is especially important in military operations other than war (MOOTW) when restraint and limitations on the use of deadly force are necessary.”¹⁶

The *Universal Joint Task List* also mentions attack using nonlethal means at the strategic, operational, and tactical levels.¹⁷ And draft JP 3-70, *Joint Doctrine for Strategic Attack*, mentions nonlethal weapons use at the low end of the conflict spectrum. However, nowhere in joint doctrine is there discussion more extensive than that quoted above. Likewise, while several joint pubs mention the issue of limiting collateral damage, there is no focused discussion on the topic in joint doctrine. For example, JP 3-0, *Doctrine for Joint Operations*, cautions that JFCs “. . . apply the combat power necessary to ensure victory against combatants, but are careful to limit

¹⁵ Chairman of the Joint Chiefs of Staff Instruction (CJCSI) 3010.02A, *Joint Vision Implementation Master Plan (JIMP)*, 15 April 2001. The JIMP identifies seven key areas in which to capture desired future capabilities: doctrine, organization, training, materiel, leadership and education, personnel, and facilities (DOTMLPF).

¹⁶ JP 3-09, 12 May 1998, p. I-7.

¹⁷ CJCSI 3500.04C, *Universal Joint Task List Version 4.2*, 1 July 2002. Tasks SN 3.3.4, “Apply National Nonlethal Capabilities;” ST 3.2.2, “Conduct Attack on Theater Strategic Targets/Target Sets using Nonlethal Means;” OP 3.2.2, “Conduct Attack on Operational Targets using Nonlethal Means;” and TA 3.2.6, “Conduct Joint Attacks using Nonlethal Means.”

unnecessary injury to noncombatants and damage, especially to protected sites.” JP 2-01.3, *JTTP for Joint Intelligence Preparation of the Battlespace*, states “Exclusion zones . . . may be used to reduce neutrals’ exposure to collateral damage and incidental injury . . .” Similarly, JP 3-60, *Joint Doctrine for Targeting*, states “Target development also assesses collateral damage considerations and LOAC and ROE limitations.” Even JP 3-12.1, *Doctrine for Joint Theater Nuclear Operations*, limits discussion of collateral damage to a mention of planning factors associated with targeting and employing nuclear weapons. There is similar mention of collateral damage in a number of other joint pubs.

Collateral damage estimation has evolved to a sophisticated state. Although they are not doctrinal publications, documents such as the *Joint Munitions Effectiveness Manual* contain detailed data on a wide array of weapons and provide a statistical starting point for damage estimation. Other manuals provide quantitatively based guides to estimating both collateral damage and casualties, and can be used to estimate both kinetic and nonkinetic effects. And various computer tools greatly enhance the speed of the estimation process and accuracy of the results. Finally, both joint and Service training associated with targeting includes instruction on estimating and mitigating collateral damage.

Perspectives

One point of view on the question of joint doctrine sufficiency is that current doctrine says exactly what it should about using nonlethal means and limiting collateral damage. Proponents of this view would contend that collateral damage would always be an important planning consideration, but that current doctrine is sufficient as long as relevant publications like JP 3-60 and JP 5-00.2 (*Joint Task Force Planning Guidance and Procedures*) mention it. The JFC always should have a variety of ways and means available to accomplish the mission. As the set of LCDC grows, the JFC will have more employment options. But except for JPs that cover employment of nuclear weapons (the JP 3-12 series) and mines (JP 3-15), we typically do not write joint doctrine to cover specific weapons.

An opposite perspective is that current doctrine is deficient and we need a new doctrine pub focused on low collateral damage operations. Proponents of this view could argue that LCDC employment described in the hypothetical examples in Section III demonstrates such significant beneficial possibilities that this could radically change the way the JFC plans and employs the joint force if an array of LCDC was available. This perspective supports the contention by Steven Metz, mentioned earlier, that nonlethality will be a defining characteristic of the second revolution in military affairs.

Between these two points of view, of course, is one that argues for amplifying our current doctrine to clarify how we might use LCDC but contends that a new joint pub is not required. In the immediate future, perhaps we should add an LCDC section to selected joint pubs that contains principles, planning factors, and employment

considerations. However, since we write joint doctrine to describe operations with current capabilities, we should guard against straying into the conceptual arena in our doctrine. Nonetheless, since our doctrine developers are joint operations subject matter experts in their areas of focus, they should closely monitor LCDC conceptual efforts in order to project the doctrinal impact of emerging capabilities.

Conclusions

This pamphlet has introduced LCDC as a new term and category that could subsume related capabilities currently described as “nonlethal” and “nonkinetic.” This is not a formal proposal to include this term in joint doctrine, but rather an attempt to stimulate thinking about how to group and use these related capabilities.

Fielding an array of LCDC would seem to provide the JFC with expanded ways and means to accomplish operational and strategic objectives. DARPA and the national laboratories are currently investigating a number of capabilities that can achieve desired effects while limiting collateral damage. USJFCOM J-9 examined some alternatives for operational-level utility during their limited objective experiments and determined that LCDC could be just as effective as traditional systems in creating target effects required by the joint force in certain situations, but with fewer sorties and significantly reduced collateral damage. However, experimentation to date has not been comprehensive enough to examine a full range of possible LCDC ways and means in a variety of situations.

If LCDC could fundamentally change the way the joint force plans and executes joint operations, then joint doctrine might require substantial revision.

Employment of an individual LCDC in a specific engagement likely would not change the way the JFC and joint force planners structure the joint campaign. However, the availability of a full array of LCDC could provide the JFC with alternative campaign strategies. Likewise, the joint community can modify doctrine incrementally, if required, as LCDC become available. However, if LCDC could fundamentally change the way the joint force plans and executes joint operations, then joint doctrine might require substantial revision. Collateral damage estimation methods and tools must keep pace as LCDC employment becomes more prevalent. And as with any other capabilities we develop for offensive use, we must consider defensive measures against a potential adversary’s use of similar capabilities against our forces. **At present, the potential value and associated DOTMLPF impact of LCDC are best explored through continued concept development and experimentation.**

USJFCOM JWFC welcomes comments on these and other perspectives concerning the potential impact of LCDC development on joint doctrine.

Appendix A

Examples of Actual and Potential LCDC Technologies and Systems

System	Personnel Effects
Ultrasonic generator	Projects an acoustic pressure wave to cause discomfort
Acoustic generator	Projects noise to cause disorientation
Incapacitating Substances	Inorganic and organic substances that cause temporary disability
Malodorous substances	Create pungent odors that repel
Irritants	Cause eye and respiratory discomfort
Vomiting agents	Cause nausea and vomiting
Non-penetrating projectiles	Stun personnel without penetrating
High-intensity strobe lights	Disorient and confuse
Stun weapons	Subdue or immobilize
Water cannon	Disperse crowds
Optical munitions	Stun, dazzle, or temporarily blind
Super adhesives	Immobilize personnel
Anti-traction substances	Prevent the movement of personnel
Entanglement devices	Ensnare and immobilize
Enclosure fillers	Rapidly fill an enclosed space, immobilizing personnel
Aqueous foams	Impede mobility and create barriers
Hologram generator	Produces holograms as decoys
Marking agents	Overtly and covertly mark personnel for later identification
Obscurants	Disorient and obscure visual observation
Deception operations	Influence adversary decision maker
Psychological operations	Influence adversary military and civilian population

System	Materiel Effects
Binding coatings	Super adhesives that prevent vehicle movement
High-voltage generator	Disrupts electronic systems
Non-nuclear EMP	Disrupts electronic systems
Engine killing agents	Disable or destroy engines
Filter clogging agents	Clog engine filters, disabling engines
Conductive particles	Short-circuit electronics
Fuel additives	Change fuel characteristics, disabling engine
Obscurants	Obscure electronic observation
Optical munitions	Stun, dazzle, or blind weapon and other system optics
Anti-traction substances	Prevent the movement of vehicles
Soil destabilization	Change soil characteristics, preventing the movement of vehicles
Computer network attack	Disable computer systems and networks
Computer worms & viruses	Disable computer systems and networks
"Smart fish"	Disable hydroelectric power plants
Carbon fiber munitions	Disable locomotives and other engines
Directed-energy systems	Precision engagement and destruction of targets

Glossary

Part I — Abbreviations and Acronyms

ACTD	Advanced Concept Technology Demonstration
CJCS	Chairman of the Joint Chiefs of Staff
CNA	computer network attack
DOTMLPF	doctrine, organizations, training, materiel, leadership and education, personnel, and facilities
EBO	effects-based operations
GPADS	guided parafoil air delivery system
IO	information operations
JASSM	Joint Air-to-Surface Standoff Missile
JCATS	Joint Combat and Tactical Simulation
JCDE	Joint Concept Development and Experimentation
JFC	joint force commander
JIMP	Joint Vision Implementation Master Plan
JP	joint publication
JSOW	Joint Standoff Weapon
JWFC	Joint Warfighting Center
KT	kinetic technologies
LCDC	low collateral damage capabilities
LCDW	low collateral damage weapons
LOE	limited objective experiment
NKT	nonkinetic technologies
NLW	nonlethal weapons
ONA	operational net assessment
<i>PFJO</i>	<i>Pamphlet for Future Joint Operations</i>
SJFHQ	standing joint force headquarters
SME	subject matter expert
TUGS	tactical unattended ground sensor
TTP	tactics, techniques, and procedures
UAV	unmanned aerial vehicle
UJTL	Universal Joint Task List
USJFCOM	United States Joint Forces Command

Part II — Terms and Definitions

Collateral Damage. Unintentional or incidental injury or damage to persons or objects that would not be lawful military targets in the circumstances ruling at the time. Such damage is not unlawful so long as it is not excessive in light of the overall military advantage anticipated from the attack. (JP 1-02)

Low Collateral Damage Capabilities (LCDC). Those weapons, technologies, and other capabilities that have the specific capacity to precisely achieve a desired effect on an adversary capability (individual target, system, or function) while minimizing collateral damage and casualties. (proposed for discussion purposes)

Low Collateral Damage Weapons (LCDW). Those weapon technologies or systems that have the specific capacity to precisely attack an adversary function while minimizing collateral damage and casualties. (J-9 Interim Report on NKT and LCDW).

Nonlethal Weapons (NLW). Weapon systems that are specifically designed and primarily employed so as to incapacitate personnel or materiel, while minimizing fatalities, permanent injury to personnel, and undesired damage to property and the environment. (DOD Directive 3000.3)

"The joint force, because of its flexibility and responsiveness, will remain the key to operational success in the future. To build the most effective force for 2020, we must be fully joint: intellectually, operationally, organizationally, doctrinally, and technically."

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