

An Assessment of Non-Lethal Weapons Science and Technology

Committee for an Assessment of Non-Lethal Weapons
Science and Technology

Naval Studies Board

Division on Engineering and Physical Sciences

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Preface

As part of the nation's national security strategy, naval forces remain deployed throughout the world, engaged in or ready to support operations ranging from training exercises with joint and allied coalition partners, to humanitarian relief efforts, to peacekeeping and peace enforcement, to combat. Non-lethal weapons provide one means by which expeditionary forces can accomplish their missions, particularly in urban areas, with a reduced likelihood of death and injury to non-combatant civilians who might be encountered, for example, in hostage rescue or human shielding operations. As a result of the National Defense Authorization Act of 1996 and because of Marine Corps initiative and experience, the Commandant of the Marine Corps was designated the executive agent for joint Service research, development, testing, and evaluation of non-lethal weapons and non-lethal weapons technologies.

Operating with a yearly budget of approximately \$25 million, the Joint Non-Lethal Weapons Directorate (JNLWD) is executing these responsibilities. Less than \$1 million of this amount is used to support new technology development. Currently, the role of the JNLWD in areas related to information warfare and psychological warfare and with respect to single-Service activities is limited to coordination and integration. At issue for the Department of the Navy is to what extent and in what areas Navy-sponsored science and technology should provide a research base for developing non-lethal weapons capabilities.

Non-lethal weapons consist of a diverse array of individual weapons that minimize fatalities and undesired damage to property and the environment. They function in three realms: those of (1) counterpersonnel objectives, which include controlling crowds; incapacitating individuals; denying areas to personnel; and clearing personnel from facilities, structures, or areas of operation; (2) countermateriel objec-

tives, which include denying areas to vehicles, vessels, or aircraft, and disabling or neutralizing vehicles, vessels, aircraft, or equipment; and (3) countercapability objectives, which include disabling or neutralizing facilities and systems and denying use of weapons of mass destruction.

Non-lethal weapons technologies cover a broad spectrum, including areas related to the development of acoustics systems, chemicals (e.g., antitraction materials, dyes, markers, and malodorants), communications systems, electromagnetic and electrical systems, entanglement and other mechanical systems, information technologies, optical devices, non-penetrating projectiles and munitions, and many others. Combinations of non-lethal and lethal weapons are possible. Synergy of non-lethal weapons with psychological, information, and/or electronic warfare in a networked fashion could be especially effective. As non-lethal weapons are developed and acquired, it is especially important that training, delivery, deployment, control, logistics, maintenance, and doctrine for use are in hand. Forward-deployed, distributed naval forces offer great potential for timely use of non-lethal weapons in a variety of scenarios.

TERMS OF REFERENCE

At the request of the Joint Non-Lethal Weapons Directorate and the Office of Naval Research, the Naval Studies Board of the National Research Council conducted an assessment of non-lethal weapons science and technology that addressed the following terms of reference:

- Review the previous non-lethal weapons studies and initiatives, and assess their response along with any DOD response.
- Review the current and planned non-lethal weapons program of record as executed by the Joint Non-Lethal Weapons Directorate under the charge of the Commandant of the Marine Corps.
- Review and identify current and planned Department of the Navy science and technology programs (budget categories 6.1-6.3) that currently do or could in the future contribute to the development of non-lethal weapons' capabilities.
- Identify technology developments (including synergies of technologies) that show promise for enhancing existing non-lethal weapons capabilities or developing new non-lethal weapons capabilities for use by naval expeditionary forces. These capabilities should not be limited to weapons exclusively, but also should include training, handling, control, delivery, logistics and maintenance support, countermeasures, and doctrine (or operational concepts) development.
- Identify programs that may represent duplication of effort or could benefit from leveraging of resources.
- Recommend science and technology program actions that might be initiated by the Office of Naval Research in support of naval expeditionary force needs for non-lethal weapons.

This final report reviews and projects technology developments; identifies promising areas for research in science and technology; identifies duplication or leveraging opportunities; and addresses broader issues related to training, handling, control, delivery, logistics and maintenance support, countermeasures, and development of operational concepts.

COMMITTEE MEETINGS

The Committee for an Assessment of Non-Lethal Weapons Science and Technology first convened in February 2001 and held additional meetings and site visits over a period of 7 months:¹

- *February 1-2, 2001, in Washington, D.C.* Organizational meeting: Joint Non-Lethal Weapons Directorate briefings on historical perspectives, current capabilities, joint concepts, existing Service mission need statements, assessment of science and technology needs, previous studies, airborne tactical laser advanced concept technology demonstration (ACTD), and foreign exchange agreements.

- *March 6-7, 2001, in Washington, D.C.* Marine Corps Combat Development Command briefings on Marine Corps non-lethal weapons (NLWs) concepts and requirements; Marine Corps Warfighting Laboratory briefing on non-lethal weapons experimentation; Marine Corps Systems Command briefing on non-lethal weapons acquisition management; Headquarters U.S. Marine Corps briefing on the Marine Corps perspective on directed energy; U.S. Army Training and Doctrine Command briefing on weapons requirements, concepts, and experimentation; U.S. Coast Guard Headquarters Support Command briefing on current and planned use of NLWs; Naval Sea Systems Command (NAVSEASYSCOM) briefing on NAVSEASYSCOM perspective on NLWs; the Secretary of the Navy's Antiterrorism/Force Protection Task Force briefing on actions stemming from the attack on the USS *Cole*; and U.S. Army Program Manager for Mines, Countermines, and Demolition briefing on the non-lethal weapons program for mines, countermines, and demolition.

- *April 3-4, 2001, in Washington, D.C.* Naval Research Laboratory briefing on high-energy lasers and high-power microwave/millimeter-wave source technology; U.S. Army Soldier and Biological Command overview of non-lethal weapons science and technology; Marine Corps Judge Advocate Division International and Operational Law Branch briefing on legal issues affecting non-lethal weapons policy; National Institute of Justice overview of NLWs; U.S. Joint Forces Command overview of experimentation and technical initiatives related to NLWs and low-collateral-damage weapons; U.S. Special Operations Command

¹During the entire course of its data gathering, the committee held meetings closed to the public in which it received (and discussed) classified material. Accordingly, the content of this report is limited by restrictions to classification.

overview of non-lethal weapons science and technology requirements, concepts, and experimentation.

- *April 29-30, 2001, in San Antonio, Texas, and Albuquerque, New Mexico.* Site visit to Brooks Air Force Base, Kirtland Air Force Base, and Sandia National Laboratories for briefings on the Air Force non-lethal weapons perspective, overview of non-lethal weapons human effects, Human Effects Advisory Panel, joint non-lethal weapons program Human Effects Center of Excellence, tri-Service radio-frequency/microwave/millimeter-wave bioeffects program, tri-Service laser bioeffects program, antisensor laser (Medusa), infrastructure, vehicle stopper, modeling and simulation effects, active denial technology, and Los Alamos National Laboratory and Lawrence Livermore National Laboratory non-lethal weapons initiatives.

- *May 16-17, 2001, in Washington D.C.* Small group visit to Office of Naval Intelligence for Small Boat Threat Workshop.

- *May 21, 2001, in Aberdeen, Maryland.* Small group visit to Edgewood Chemical and Biological Command.

- *June 12-14, 2001, in Washington D.C.* Deputy Study Chair briefing on 2000 Air Force Scientific Advisory Board study *Technologies to Leverage Aerospace Power in Operations Other Than War*; U.S. Air Force Headquarters Security Forces overview of non-lethal weapons concepts, experimentation, and requirements; Defense Threat Reduction Agency briefing on protecting U.S. Navy ships in foreign ports; Potomac Institute for Policy Studies briefing on Center for Emerging Threats and Opportunities; Mission Research Corporation briefing on pulsed-energy projectile program; U.S. Army Center for Health Promotion and Preventive Medicine briefing on health hazard analyses; Walter Reed Institute for Research briefing on interim total body model; and Science Applications International Corporation briefing on loitering electronic warfare killer ACTD. Also, in an effort to frame potential applications of NLWs for U.S. Navy operations (and the supporting technology options and system concepts to meet those operational needs), the committee held a 1-day data-gathering session with representatives from the Office of the Chief of Naval Operations, the Chief of Naval Operations Strategic Studies Group, the Joint Non-Lethal Weapons Directorate, the Office of Naval Research, the Navy Warfare Development Command, the Office of Naval Intelligence, the Naval Research Laboratory, the Naval Surface Warfare Center Dahlgren Division, the Space and Naval Warfare Systems Command, the U.S. Coast Guard Non-Lethal Weapons Center of Excellence, and the Applied Research Laboratory/Pennsylvania State University.

- *July 16-20, in Woods Hole, Massachusetts.* Committee deliberations and report drafting.

The months between the last meeting and publication of the report were spent preparing the draft manuscript, reviewing and responding to the external

review comments, editing the report, and conducting the required security review necessary to produce an unclassified report.

Following completion of the security review a prepublication copy of the report was released to the public on November 4, 2002. Subsequent to that release, it became apparent that the Department of Defense and the Department of State have differing legal interpretations of the Chemical Weapons Convention as it pertains to the development of chemical non-lethal weapons for military purposes. As a consequence, and in recognition that it was not the mandate of the committee to conduct a legal review of the permissibility of non-lethal weapons as it relates to the Chemical Weapons Convention (and other national and international law and treaties), a brief discussion of legal considerations has been excised from the final report. In doing so the committee recognizes that it is of paramount importance that the Department of Defense and the Department of State clarify the legal interpretations of the Chemical Weapons Convention so that both the operational and technical communities can move forward under consistent guidelines.

Acknowledgment of Reviewers

This report has been reviewed in draft form by individuals chosen for their diverse perspectives and technical expertise, in accordance with procedures approved by the National Research Council's Report Review Committee. The purpose of this independent review is to provide candid and critical comments that will assist the institution in making its published report as sound as possible and to ensure that the report meets institutional standards for objectivity, evidence, and responsiveness to the study charge. The review comments and draft manuscript remain confidential to protect the integrity of the deliberative process. We wish to thank the following individuals for their review of this report:

Richard L. Garwin, IBM Thomas J. Watson Research Center,
Larry G. Lehowicz, USA (Ret.), Quantum Research International,
John (Ted) Parker, USN (Ret.), Annapolis, Maryland,
John E. Rhodes, USMC (Ret.), Balboa, California,
Charles F. Sharn, McLean, Virginia, and
Peter R. Worch, Leonardtown, Maryland.

Although the reviewers listed above have provided many constructive comments and suggestions, they were not asked to endorse the conclusions or recommendations, nor did they see the final draft of the report before its release. The review of this report was overseen by John W. Rouse, Southern Research Institute. Appointed by the National Research Council, he was responsible for making certain that an independent examination of this report was carried out in accordance with institutional procedures and that all review comments were carefully considered. Responsibility for the final content of this report rests entirely with the authoring committee and the institution.

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Prologue

September 11, 2001, was a defining day in the history of the United States of America, if not the world. The unprecedented disasters in New York and Washington, D.C., have placed the nation on a wartime footing, and we have formally acknowledged our battle against terrorism. The implications for warfighting and law enforcement have yet to be fully understood, but most would agree that profound shifts in emphasis and investment are likely to come. In rooting out terrorism's infrastructure, there will be times when controlled application of force will be essential and unconstrained violence counterproductive to our strategic goals. Moreover, punishing attacks that destroy the overt support system for terrorists will not be sufficient to weed out well-hidden infrastructure, some of which already resides on U.S. soil. As the immediate emotional circumstances fade, the need to isolate a few individuals, both in the United States and abroad, most likely in and amongst civilian populations, will remain critically important. In that context, non-lethal weapons may play an even greater role in matters of national security.

Of particular concern to the Navy will be yet greater emphasis on base security and force protection as the links between the events of September 11 and the USS *Cole* incident begin to be made. This report addresses those issues but could not fully appreciate the new complexities in which those missions are likely to be executed. For the U.S. Marine Corps the focus on Military Operations in Urban Terrain is likely to take on added importance, with minimization of collateral casualties and damage being of the utmost importance for maintaining fragile coalition relations with Middle Eastern states in particular. This report emphasizes the role of non-lethal weapons

for those missions, but the emerging political climate elevates to a strategic level the importance of controlled use of force.

In this milieu, the development and deployment of more capable non-lethal weapons should be given a higher priority. This report was in review on September 11. None of its recommendations have been altered by the events of that day—but the urgency in their acceptance and implementation has.