WPSTC
Weapons & Protective Systems Technologies Center

A GUIDEBOOK

For

LESS-LETHAL DEVICES

Planning for, Selecting, and Implementing Technology Solutions

SECOND EDITION
September 2013

This guide was prepared for the National Institute of Justice, U.S. Department of Justice, by the Weapons and Protective Systems Technologies Center at The Pennsylvania State University under Cooperative Agreements 2007-MU-MU-K005 and 2010-IJ-CX-K005. It is intended to provide information useful to law enforcement and corrections agencies regarding technology planning, selection, and implementation. It is not proscriptive in nature, rather it serves as a resource for program development within the framework of existing departmental policies and procedures. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the authors/editors and do not necessarily reflect the views of the National Institute of Justice. They should not be construed as an official Department of Justice position, policy, or decision.

This is an informational guidebook designed to provide an overview of less-lethal devices. Readers are cautioned that no particular technology is appropriate for all circumstances and that the information in this guidebook is provided solely to assist readers in independently evaluating their specific circumstances. The Pennsylvania State University does not advocate or warrant any particular technology or approach. The Pennsylvania State University extends no warranties or guarantees of any kind, either express or implied, regarding the guidebook, including but not limited to warranties of non-infringement, merchantability and fitness for a particular purpose.

FOREWORD

The National Tactical Officers Association (NTOA) is the leading authority on contemporary tactical law enforcement information and training. The NTOA maintains many working partnerships in its effort to bring current and meaningful information to law enforcement officers of all disciplines. Among the leading partnerships are the relationships with the National Institute of Justice (NIJ) of the U.S. Department of Justice and the Weapons and Protective Systems Technologies Center (WPSTC) at the Pennsylvania State University. The Guidebook for Less-Lethal Devices is a product of the work done in part by the NIJ Technology Working Group on Less-Lethal Devices.

This Guidebook (2nd Edition) is an excellent overview of the current problems, concepts and technology gaps that we all share. Changes in this edition include:

- Modifications to scenarios and worksheets (Annex A);
- New terms added (Annex B);
- A summary of Excited Delirium Syndrome (Annex C);
- FSDDs and ATF storage requirements (Chapter 4);
- Tire Deflation Device attributes (Chapter 4);
- Tactical Aim Point discussion (Chapter 4); and
- Tactical Decision-making discussion (Chapter6).

As a member of the law enforcement community I applaud the members of the working group for creating such a useful and thorough manual. Most importantly, the information is now available for law enforcement and military practitioners who need factual and current information in a codified format. This information is available to law enforcement personnel upon request from the WPSTC or from the NTOA Resource Library.

DON WHITSON
Less-Lethal Section Chairperson
National Tactical Officers Association

EDITORS

Lieutenant Colonel Edward L. Hughes
United States Army (Retired)

and

Commander Robert A. Osborne
Los Angeles County Sheriff's Department (Retired)

ACKNOWLEDGEMENTS

This guidebook (Second Edition) is a product of the Weapons and Protective Systems Technology Center at The Pennsylvania State University and the National Institute of Justice Technology Working Group (TWG) on Less-Lethal Devices. Authors and contributors include members of the TWG and selected staff at Penn State's Institute for Non-Lethal Defense Technologies. It is particularly important to acknowledge the initial research conducted by Mr. Kirk Hessler of the Center for Community and Public Safety at Penn State who crafted the original chapter, *Overview of Technologies*. Additionally, Commander Charles "Sid" Heal, formerly of the Los Angeles County Sheriff's Department (LASD) and a retired Chief Warrant Officer (CWO5) of the U.S. Marine Corps Reserve, contributed portions of the original chapters on *Technology Planning, Acquisition and Management* and *Challenges to Implementation.* Finally, Sergeant Don Whitson contributed sections on *Tactical Aim Points* and *Tactical Decision-Making.*

COMMENTS

This guidebook was designed for law enforcement and corrections officer use. Comments and recommendations for improvement are welcomed and encouraged. Comments may be forwarded to:

Weapons & Protective Systems Technology Center
Applied Research Laboratory
The Pennsylvania State University
P.O. Box 30
State College, Pennsylvania 16804-0030
Office: (814) 865-8110
Facsimile: (814) 865-9830
Email: *WPSTC@arl.psu.edu*

TABLE OF CONTENTS


WPSTC

1 INTRODUCTION

Using this Guide

This guide is designed to provide a comprehensive view of less-lethal technologies, their evolutionary role in criminal justice, and considerations when acquiring such devices to meet operational needs. It is segregated into six self-contained chapters which provide information and insight into specific areas of inquiry.

The first three chapters provide background information on less-lethal device evolution and use as well as a synopsis of development and testing. Chapter 4 provides an overview of less-lethal technologies. The final two chapters provide a framework for program development.

Endnotes are provided for each chapter to clarify or augment information provided in the text and to identify reference and source material.

Historical Background

Whether the topic is community policing or the military battlefield, the concept of limiting the application of force to something short of lethality has been applied for centuries with varying degrees of success. In recent decades, however, there have emerged technologies and devices that permit the application of varying levels of force while reducing the probability of injury or death.

POLICE COLT .38 SPECIAL

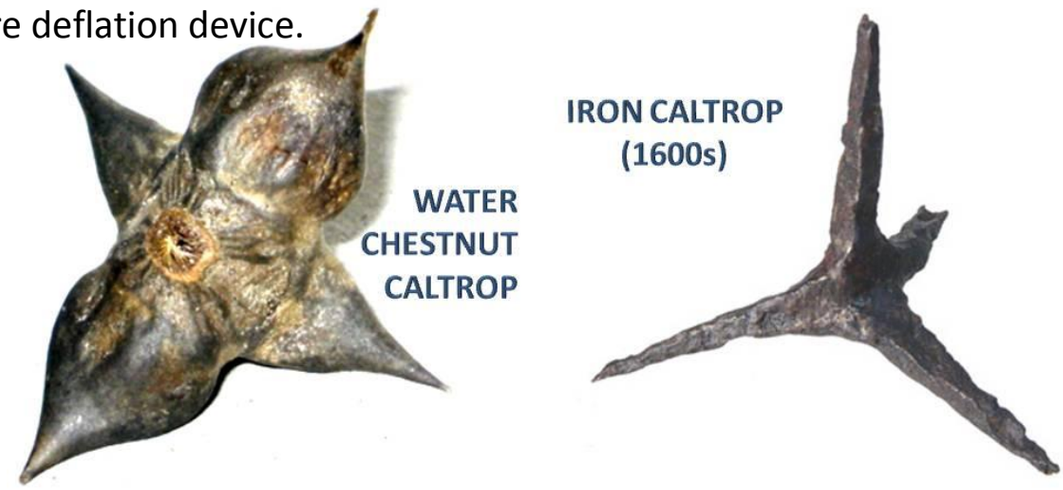
TRUNCHEONS

In a strategic military context, nations have exerted diplomacy and other forms of national power to influence the behavior of other nations to avoid the high costs of war. At the same time, the international community has long sought more humane ways to conduct warfare. In 1863, Russians developed a bullet that exploded on contact with a hard substance for the purpose of blowing up ammunition wagons. In 1867, the projectile was modified to explode on contact with soft substances.

The Declaration of St. Petersburg in 1868 sought to ban the use of fragmenting, explosive, or incendiary small arms ammunition. The language of the declaration stated that their employment would be "contrary to the laws of humanity." This is now a common theme of domestic and international laws and protocols.[1,2]

For over a century, police officers on patrol in the United States have been armed with riot batons or truncheons and/or a firearm (pistol). In the mid-1900s, with the introduction of firefighting systems to major cities, police discovered that high-pressure fire hoses provided a relatively safe and non-lethal option for dispersing crowds, particularly in an era when other alternatives were far more harsh. This included use of water cannons and fire trucks for the same purpose.

The earliest recorded use of caltrops to slow the movement of enemy horses, camels, and war elephants was perhaps at Gaugamela (331 BC) in the unsuccessful Persian defense against Alexander the Great. The next recorded use was in 637 at the Battle of Jalula, during the conquest of the Sasanid Persian Empire by the Muslim Arabs.[3] Caltrops continued to evolve independently in both China and Europe during the Middle Ages. In the East, dried water caltrops (one of the two species of water chestnuts) were strewn on the ground. No matter how they fell, their form provided one thorn sticking straight up. Later versions were developed to be even more effective against heavy cavalry as they were made out of twisted iron or steel. Today caltrops are used as a tire deflation device.



The early use of chemicals was as a tear-inducing irritant. During World War I, the French were first to employ tear gas (August 1914). The small quantities were not even detected by the Germans. The Germans developed their own equally ineffective versions of tear gas before deploying chlorine and other caustic and toxic agents. Tear gas provided a nonlethal method of testing gas masks and was eventually employed as a less-lethal agent by the Parisian police in 1912 to capture a gang of bank robbers. Within a few years the concept of tear gas as a less-lethal weapon, especially for use in riot control, was embraced worldwide. After the war, tear gas was adopted by police departments in the U.S. and was used increasingly in the 1930s.

Oleoresin Capsicum (OC) is a very old less-lethal device. It dates back to warfare between China and India 2,000 years ago, when finely ground red peppers were folded into rice paper, set on fire, then thrown or shot at the enemy with a bow and arrow. Peppers would also be blown into the face of adversaries during hand-to-hand combat. In 1492, the Spanish encountered Mexican natives who burned peppers in oil to create an irritating and suffocating smoke. [4]

1937 – Police officers fire tear gas at violent strikers

(Photo courtesy AP / Wide World)

In 1921, the Edgewood Arsenal in Maryland conducted tests of OC using human subjects. In 1930, the U.S. military investigated possible uses of OC, but dropped the program when it could find no delivery method that met battlefield needs. [5]

Around 1960, U.S. Postal Service mail carriers began using a product marketed in spray aerosol form as a dog repellent. The product contained 35 percent OC by volume.[6]

Trained police dogs were also commonly used to scare and disperse rioters and/or apprehend single subjects. Horses have been used for hundreds of years as a means of persuasion and intimidation to manage large crowds.


INLDT Photo

Source: Unknown

Police dogs and horses used in crowd control

The introduction of kinetic impact rounds such as rubber bullets and "bean bag" flexible batons was an evolution from the tactic of “skip firing” shot. The British experience in Northern Ireland in the late 1960s and 1970s saw extensive use of less-lethal technologies. Initially ill-prepared to deal with the riots and street battles, British police and military forces assembled a considerable array of less-lethal weapons. At first, these included water cannon and riot control agents. British forces later adopted plastic and rubber bullets, based on a wooden baton round previously used by Hong Kong police to respond to riots in that British colony.[7]

In the 1980s, officers began deploying personal devices, such as pepper spray and conducted energy devices (CEDs), which also found a market in private citizen self-defense. By the late 1990s, many police agencies adopted pepper spray delivery systems based largely on the equipment used in recreational paintball systems. Today, there continues to be a growing number of technologies being deployed by police in the operational contexts of corrections, crowd control, single aggressor, and pursuit management.

Conflict Management & Use of Force Models

Police and corrections officers manage conflict on a daily basis primarily leveraging their individual and collective communications skills. Training and experience enhance these skills considerably. Rarely, situations require officers to subdue and control violent, assaultive, or resistive individuals. These situations require officers to respond quickly and appropriately while protecting themselves, other officers, and the public from harm. Risk analysis and decisions regarding the appropriate use of force are always made under stressful and dynamic conditions. Clear and straightforward policies regarding use of force, as well as systematic training and evaluation programs on those policies, enhance the ability of officers to respond.

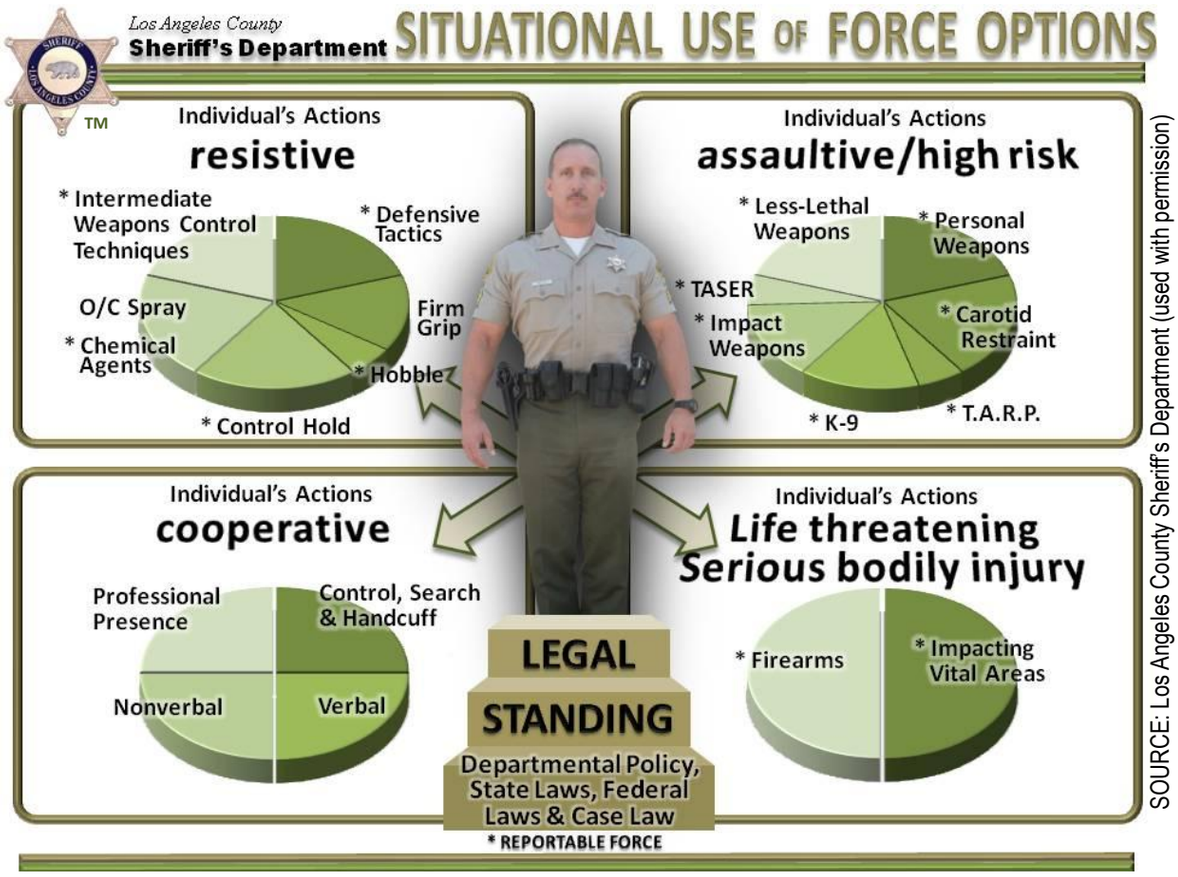
Lawful use of force is judged in U.S. courts by evaluating the severity of the suspected crime, the immediacy of the threat to officers and/or to the public, and whether the suspect was actively resisting or attempting to escape. This was established by the U.S. Supreme Court in Graham v. Connor, 490 U.S. 386 (1989). Additionally, the Court insisted that appropriate use of force should be judged from the perspective of the officer, the totality of the circumstances at the time, and did *not* have to be the least available:

> The "reasonableness" of a particular use of force must be judged from the perspective of a reasonable officer on the scene, and its calculus must embody an allowance for the fact that police officers are often forced to make split-second decisions about the amount of force necessary in a particular situation. [Graham v. Connor, 490 U.S. 386 (1989)]

Consideration should also be given to the degree of threat posed by the suspect (to officers or the public), the suspect's history of mental illness (if known), and/or level of impairment from alcohol or drugs. [Sharrar v. Felsing, 128 F.3d 810 (1991); Krueger v. Fuhr, 510 U.S. 946 (1993)]

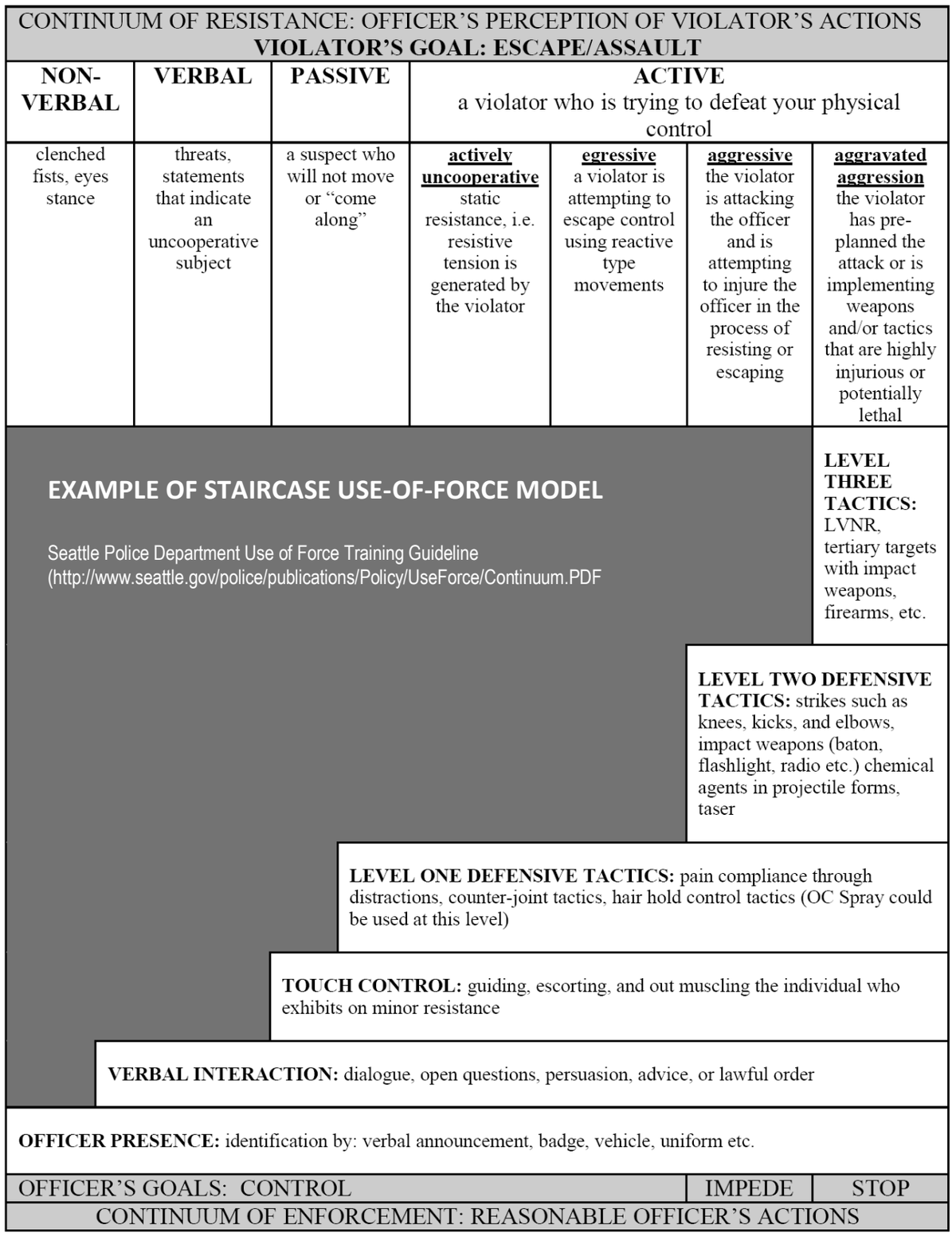
Law enforcement and corrections agencies at all levels across the country have developed use-of-force policies that incorporate federal, state and local laws, as well as case law. Policies on use of force are necessarily developed by each distinct department based on how law enforcement has evolved in the United States. There is no national policy on use of force. Although there is no standard model or methodology for describing use of force policy, there are a limited number that predominate (graphical, semicircular continuums, and linear progressions or staircases).

Quadrant Graphic. Some agencies, like the Los Angeles County Sheriff's Department, use a graphic with four quadrants representing different force options for an officer to consider based on an individual's actions and the overall situation (below). This model was designed specifically to eliminate the implication that there is a requirement to progress from one level of force to the next.

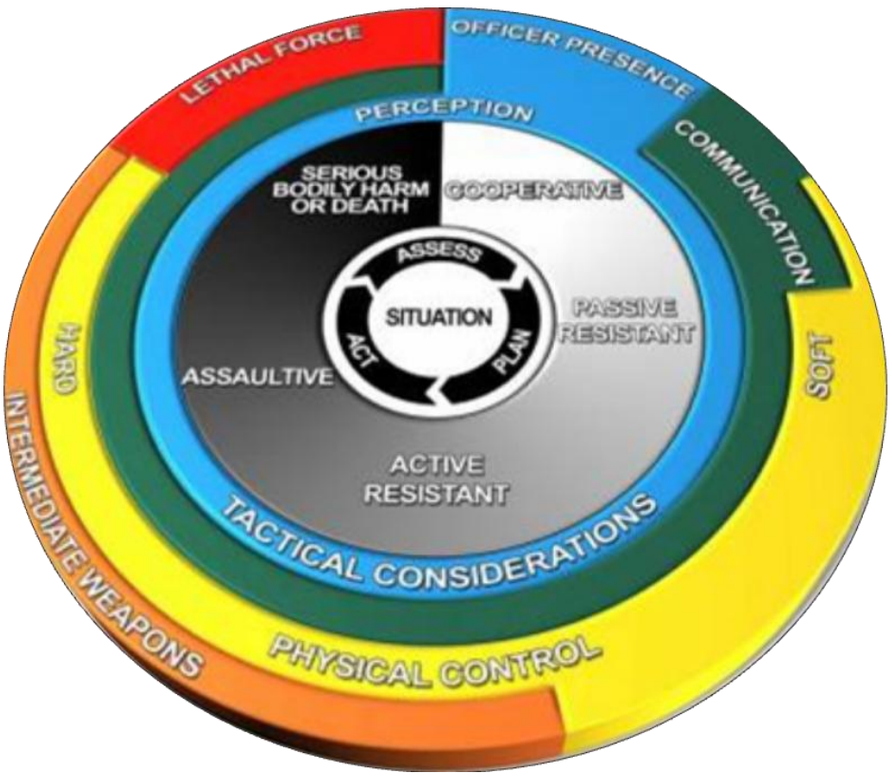


Staircase Model. In this model, each level of force yields a corresponding level of subject resistance, although it is generally noted that an officer need not progress through each level before reaching the final level of force (see example on page 1-7). These progressions rest on the premise that officers should escalate and de-escalate their level of force in response to the subject's actions.

Wheel. Canada uses a circular model called the National Use-of-Force Framework in all of their agencies (page 1-8). The National Use-of-Force Framework is not intended to serve as a justification for officer use of force nor does it prescribe specific response options appropriate to a situation.



These models or frameworks help officers understand how and why they may respond with force. They promote continuous critical assessment and evaluation of each situation and help officers understand and make use of a variety of force options to respond to potentially violent situations. Perhaps just as important, they provide a means to articulate use of force policy to the public.



Available at: RCMP website (http://www.rcmp-grc.gc.ca/)

Canadian National Use-of-Force Framework

Regardless of the method for depicting a given use of force policy, there are two common themes that surround most if not all models. First, the models are training aids for officers during initial and concurrent (or refresher) training. Second, there is no requirement to sequentially escalate from one force option to the next. Officers should select the best option given the totality of the circumstances. It is understood that these models/matrices are not to be used as an operational decision tool.

In fact, the Federal Law Enforcement Training Center (FLETC) has eliminated the use of such force models altogether as they believe them to be inherently problematic. Their position is that, beyond their ambiguity, such models conflict with the reasonableness standard outlined in Supreme Court case law by imposing more restrictions on officers than the Fourth Amendment requires. The FLETC focuses on legal training, reinforced during firearms training and reality based training programs.

Guiding Principles

The guiding principles that follow are intended to capture some of the broadly accepted principles regarding the development of force options and less-lethal technologies. These principles apply to many aspects of the use-of-force including desired technology characteristics and related policies for their employment. As guidelines, they are neither exclusive nor absolute. They are not designed to create restrictions on the rights and responsibilities of agencies or officers regarding either public safety or self-defense. Rather, they are key considerations in the future development of operational requirements and capabilities in the areas of equipment, tactics, organization, training, leader development, and support.[8]

- ✓ **Enhance Supportability of Operations**
- ✓ **Leverage Simple, Economical Technology**
- ✓ **Augment Justifiable Force**
- ✓ **Ensure Predictable Results**
- ✓ **Focus on Discriminate Applications**
- ✓ **Maintain Public Acceptability**
- ✓ **Provide Reversibility of Effects**
- ✓ **Apply Across the Range of Police Operations**

Enhance Supportability of Operations. The goal of creating new capabilities is to improve performance. As with any capability based upon new practices and advanced technology, the potential exists for less-lethal devices to generate costs (measured in terms of a police department's ability to employ resources) that outweigh their benefits. These devices must not create undue burdens. Rather, they should enhance the ability of law enforcement and corrections officers to accomplish assigned missions.

Leverage Simple, Economical Technology. Technologies with potential for generating less-lethal force capabilities cover a very broad spectrum. At the "low" end of this spectrum are capabilities which have been in use for many years with varying degrees of success. These may include riot batons, pepper spray, and "rubber bullets" or baton rounds. Their advantages are simplicity and standoff. Even today they have a greater standoff than all other classes. Their disadvantage is that they are unforgiving at too close a range (seriously injurious or even fatal) and too great a range renders them less precise, inaccurate and/or in-effective.

Augment Justifiable Force. The commitment of law enforcement organizations to resolve public crises has sometimes involved either the use of deadly force or the implicit or explicit threat of the use of deadly force. A police force armed only with traditional weapons and equipment normally has only two options for effecting compliance: maintaining a presence (essentially a threat to use deadly force) or actually employing deadly force. Less-lethal force options provide a more extensive continuum of force applications. The wider range of choices which fall between the extremes of presence and deadly force give officers the flexibility to act appropriately and often prevent escalation to the necessity to use lethal means. Through this capability and associated policies, less-lethal force options support the ideal of proportionality as it applies to public order by providing means for flexible and selective employment of force.

Ensure Predictable Results. For less-lethal technologies to realize their fullest potential, they must be capable of delivering varying levels of predictable effects. This characteristic will allow police to increase or decrease the degree of influence used to effect compliance. It is not necessary that individual devices possess such characteristics (though this can be useful), only that the family of accessible force options as a whole provide this capability.

Focus on Discriminate Applications. This describes the focus of those tactics and devices designed primarily for employment at the individual level. This distinction does not preclude the use of less-lethal force to achieve riot control objectives when circumstances warrant. Its purpose is to establish direction by focusing developmental efforts on the pursuit of individual control capabilities.

Maintain Public Acceptability. Less-lethal devices, many of which are relatively new technologies, may not have been fully tested under both laboratory and field conditions. Consequently, such weapons have not been subjected to the same level of scrutiny as have most other technologies in our inventory. Development of any less-lethal device should be evaluated by appropriate authorities to ensure that they comply with appropriate laws and ordinances. Many new capabilities are often without clear legal precedent. Additionally, a pro-active public relations approach and an open community dialogue have been demonstrated time and again to enhance public acceptance.

Provide Reversibility of Effects. Less-lethal devices should be designed to act in such a way that their effects are reversible. For example, weapons that cause temporary disorientation, passivity, pain, or otherwise diminish an adversary's ability to resist lawful authority could be suitable for consideration under minimal force options technology development programs.

Apply Across the Range of Criminal Justice Operations. Police and corrections operations vary widely in their purpose, character, and intensity, depending on the nature of the disorder. Less-lethal devices may prove useful across the range of operations, from one-on-one confrontations to large scale, organized violence and disorder. We must consider how each capability might be employed in a wide variety of scenarios.

Chapter 1 Endnotes:

[1] Nick Lewer & Steven Schofield, *Non-Lethal Weapons: A Fatal Attraction? Military Strategies and Technologies for 21st Century Conflict.* London and Atlantic Highlands, NJ: Zed Books, 1997, p.87.

[2] *Declaration Renouncing the Use, in Time of War, of Explosive Projectiles Under 400 Grammes Weight*, Saint Petersburg, 29 November and 11 December 1868, International Committee of the Red Cross, downloaded 17 March 2009, at http://www.icrc.org.

[3] Robert W. Reid, "Weaponry: The Caltrop," *Military History* magazine, August 1998, downloaded December 2009 from HistoryNet.com© 2009 (http://www.historynet.com/weaponry-the-caltrop.htm), Weider History Group, Leesburg, VA 20176.

[4] Inter-Service Non-Lethal Individual Weapons Instructor Course Manual (Fort Leonard Wood, Mo.: U.S. Marine Corps, 2004), p.9-4.

[5] United States Army, Oleoresin Capsicum: An Effective Less-Than-Lethal Riot Control Agent, Dugway Proving Ground, UT, 1997, p.1.

[6] Inter-Service Non-Lethal Individual Weapons Instructor Course Manual, p.9-4.

[7] Nick Lewer & Steven Schofield, *Non-Lethal Weapons: A Fatal Attraction? Military Strategies and Technologies for 21st Century Conflict.* London and Atlantic Highlands, NJ: Zed Books, 1997, p.59.

[8] International Law Enforcement Forum Report: Less-lethal Weapons Definitions and Operational Test Criteria, ARL Penn State, State College, PA, 15 Feb 2005.

2 OPERATIONAL CONTEXTS & CONSIDERATIONS

Operational Requirements

An operational requirement is a formal statement of a "need" containing performance and related operational parameters for a proposed concept or system. This statement must be derived from tactical level user input. The requirement can generate a number of possible solutions which might include policy changes, procedural changes, and assessment and purchase of commercial products.

In terms of less-lethal devices, an "operational requirement" might represent a new kind of weapon or piece of equipment needed by a law enforcement officer to do his/her job adequately and safely. The requirement should not normally consider the potential resource, political or technical obstacles.

Based on our federalist system of government, in the United States there are nearly 19,000 distinct law enforcement and corrections agencies (federal, state, and local). Each of these has their own discrete policies and procedures within which they operate.

While this has many advantages, one of the drawbacks is that unlike the U.S. military, it is much more difficult to agree upon requirements, consolidate resources, and conduct appropriate research, development, testing and evaluation (RDT&E). Most departments, in fact, cannot apply sufficient resources in this area. They largely rely upon the work of the bigger departments as well as that of state and federal agencies.

Operational Scenario Approach

Operational scenarios can provide focus for generating and articulating operational requirements for less-lethal devices. This approach provides a common picture of the intended end state of an operation and allows for a more precise statement of the actual operational need.

Scenarios. The scenarios below (which can change based on local variables and as needs change) were originally developed by Penn State's Institute for Non-Lethal Defense Technologies and a panel of experienced law enforcement and corrections practitioners in 2005. These scenarios were reviewed and modifications to worksheets made in 2012. This finite set of "case studies" is an integral part of a formalized thought process that allows criminal justice practitioners to

communicate needs to researchers, developers, and manufacturers in the form of operational requirements. The scenarios include:

- Single aggressor;
- Barricaded suspect;
- Non-compliant groups;
- Serious public disorder;
- Hostage rescue – clearing facilities;
- Vehicle pursuit – safely stopping a fleeing vehicle;
- Corrections – prison riot;
- Corrections – prisoner disorder.

These "situations" were selected as they encompass the vast majority of scenarios within which less-lethal technologies would be appropriate. Each description is brief and specific enough only to portray context. Environmental factors account for the variability in the situation and drive the technical, tactical, and/or procedural approaches. The panel consciously limited the scope of each individual scenario recognizing that during an encounter officers may find themselves moving from one scenario to another. Worksheets for each of these scenarios are at Annex A.

Layered Systems. There is not a single less-lethal technology available today that will meet the needs of every situation. The objective system is perhaps the STAR TREK[1] Phaser of science fiction fame. Having a range of settings (from stun to kill), it can be used on persons, crowds, or against material targets, and fires at very close or extended ranges. Until such time as science catches up with science fiction, a layered systems approach is a reasonable alternative.

STAR TREK Phaser

This simply means that multiple systems will likely be necessary to address a range of requirements across the spectrum of force. Optimally, these would be deployed simultaneously and positioned to be available as needed, recognizing this may not always be practical.

Lethal Force Overwatch. An important aspect of the layered systems approach also recognizes the need to have the ability to transition rapidly to lethal force. While this can be attained through lethal overwatch of other officers with appropriate weapons (e.g., sidearm, shotgun, automatic rifle, long rifle), there are many instances where

multiple officers may not be present or the situation precludes those officers from providing sufficient or effective overwatch. Developers and end-users must consider transition to lethal force postures given a variety of circumstances both as systems are designed and developed and as they are integrated into force policies and deployed.

Lethal force overwatch by marksman observer (left) and lethal backup (right)

Countermeasures. Preemptive or reactive efforts to negate the effects of less-lethal weapons and technologies are called countermeasures. Often anarchists in the midst of legitimate demonstrations maintain some *preemptive* countermeasures against the use of oleoresin capsicum (OC) spray or streams. The tactic of individuals rolling on the ground to remove CED probe between applications would be seen as a *reactive* measure. Countermeasures and counter-counter measures (those measures officers take to eliminate or mitigate countermeasures) should also be considered during a manufacturer's development process and by law enforcement and corrections agencies throughout the acquisition process.

Proactive countermeasures (protective masks)

After Care. Post incident care of targeted subjects, bystanders, hostages, and officers is a consideration for any use of force. Additionally, the impact of devices on facilities and property should also be considered. While some rapidly developing scenarios will only allow a reactive approach, complex and slower developing situations normally allow for a more deliberate approach whereby assets might be rapidly deployed and even prepositioned.

To the extent possible, departments should be familiar with the expected types of possible injuries associated with devices deployed by their officers. Policies should include standard procedures associated with a variety of possible outcomes. This might include preparing hasty and deliberate decontamination capabilities for riot control agents (people and material) as well as positioning emergency medical technicians (EMTs). It is also important that departments share information on capabilities in order that medical and other personnel can appropriately and effectively address after care issues. Whenever practical, after care personnel should be included and consulted in the development of hasty after care procedures and always in the deliberate planning of significant tactical operations.

SOURCE: Multiple; Origin unknown

Post-incident after is an important consideration for any use of force

Chapter 2 Endnotes:

[1] STAR TREK and related marks are trademarks of CBS Studios, Inc.

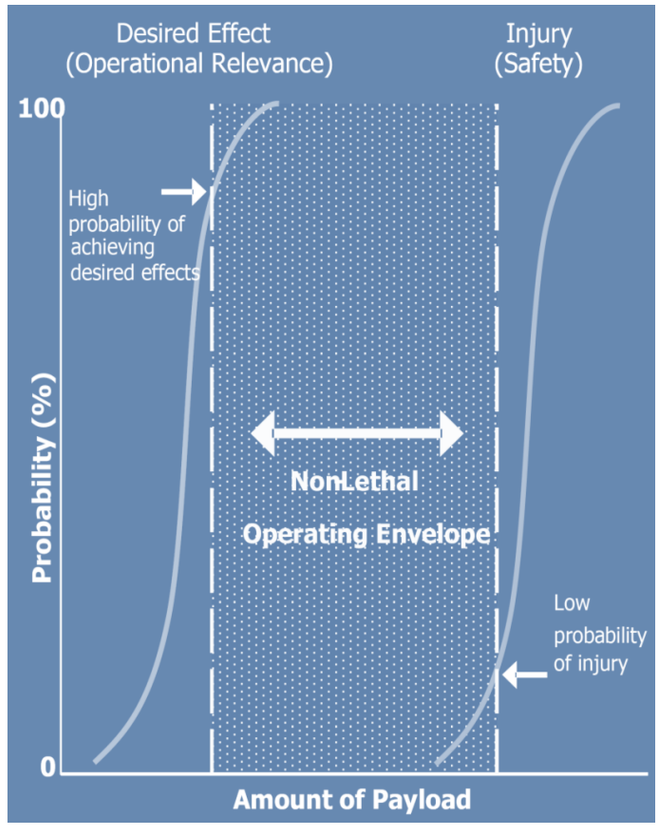
3 RESEARCH, TESTING & EVALUATION

Not all jurisdictions have the same technology requirements. A patrol officer working alone in a rural township may have different needs for less-lethal applications than an officer working with hundreds of other officers on a city street in a densely populated, large urban area. They do, however, share a common goal: *the effective use of force to gain compliance from, or control of, one or more individuals.*

Effects and Effectiveness

The need for human effects information goes beyond the development of less-lethal devices. Practitioners need this information to ensure the safe and effective deployment of devices. Sufficient knowledge of human effects is required to determine the compliance of a particular system with international laws and treaties, federal laws and regulations, and standards of policing by minimizing permanent damage, significant injury, and death. An understanding of human effects by the public promotes more realistic expectations when less-lethal weapons are deployed.

The underlying intent for less-lethal weapons is that they do not kill or cause permanent damage, and they only temporarily disable. Achieving this purpose requires a thorough understanding of the associated human effects. While standard firearms must simply achieve a lethal threshold, less-lethal devices function to achieve an effect within a window or operating envelope (left). This means that these devices have to achieve a useful and repeatable human effect (at the lower threshold) without entering the domain of serious injury or lethality (at the upper threshold).



Less-lethal operating envelope (source: Joint Non-Lethal Weapons Directorate). The military term "non-lethal" in this diagram is synonymous with "less-lethal" in law enforcement and corrections settings.

The difference between these upper and lower thresholds is often very small allowing only a narrow window/envelope within which to operate.

For most less-lethal systems, this is only part of the answer. Achieving a useful effect (or effect of interest) does not necessarily mean the system is effective for a given purpose or under certain conditions. Effectiveness is linked to the desired outcome of an event or situation – in this case, a human behavior change such as compliance. There are myriad other variables that impact on a system's potential for effectiveness including a subject's mental health and motivation as well as the type and level of intoxication (often difficult to discern and influence). Variables also include use of force policies, guidelines for use, and the experience and training level of users (normally able to influence).

Safety and Risk

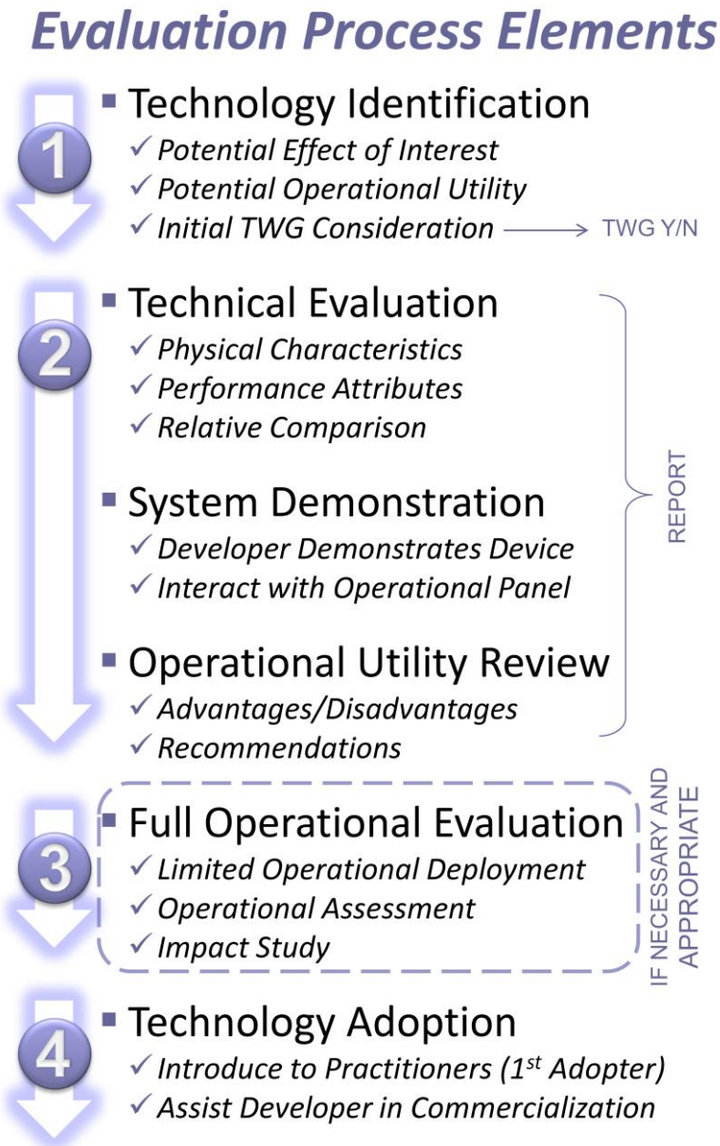
While most criminal suspects are male, mid-teens to late-twenties in age and in good physical condition, law enforcement also routinely deals with the ill, inebriated, mentally disturbed, elderly, young, large and small, male and female – whether suspects or bystanders. Moreover, the human body is not homogenous like ballistic gelatin. Some parts of the body are more vulnerable to specific weapons than others. How energy from impact projectiles is transferred to tissues and organs over time and their individual and collective response to that energy is difficult to determine with precision. Understanding biological effects is even more complex for other less-lethal technologies.

Computer and animal models are used extensively in research and testing in order to better understand how these systems affect the human body. Computer models exist for certain areas of the body like the cardiovascular system. Other models are being developed for the head and torso.

Understanding the range of possible human effects requires analysis of injury data (even anecdotal) and comparison to similar devices for which detailed injury data is available. In the future, the coupling of weapon system and technology models with developing human models will allow for better injury prediction.

Testing and Standards

Testing. There are a significant number of academic and government test facilities across the country. Additionally, depending upon the particular technology, only relatively simple tests might be needed to secure the necessary data to determine whether or not a device is useful or "effective." The NIJ works to identify promising technologies that may either fill an existing operationally-driven technology gap or provide a significant improvement over an existing capability. The NIJ, through its Weapons and Protective Systems Technologies Center, uses a framework composed of a number of steps (called evaluation process elements) when evaluating less-lethal devices (see figure below). This flexible framework provides the rigor necessary to examine complex as well as relatively simple technologies and can be a tool at the departmental level as agencies consider the acquisition of some of these technologies.



Evaluation Process Elements (source: The Weapons and Protective Systems Technologies Center)

Normally, after identifying a potential technology, a developer will provide a ***technical demonstration***. This effort is often a limited user assessment of a device to determine whether it delivers some "effect-of-interest" and whether it seems to provide a needed function.

The initial testing challenge for less-lethal weapons is the evaluation of the ability of the device to achieve specific, repeatable effects. This is the ***technical evaluation*** or ***characterization*** testing normally conducted in a controlled environment to gather physical characteristics, performance attributes and establish a relative comparison with related technologies. For example, the testing of blunt impact munitions would measure such things as velocity, precision, accuracy, mass, force, pressure, shape and composition of projectiles (with some level of statistical significance) and relate that information to specific weapon effects. Gathering this information often requires accurate and high-speed measurements or data collection equipment. It might also require distinct testing to assess the human effects and relative safety of the device. Optimally, this effects and safety testing is first conducted by the developer and provided to law enforcement as evidence of technology maturity. Subsequently, this would be independently evaluated.

One method to categorize technology maturity is the use of Technology Readiness Levels (see opposite page). The TRLs are measures used by several U.S. and international agencies to describe the maturity of evolving technologies prior to incorporating them into an operational system or application. The Department of Defense (DoD) and the National Aeronautics and Space Administration (NASA) have adopted nearly identical nine-stage TRL descriptions that provide an appropriate measure of maturity for less-lethal devices with little need for modification.

The next level of testing is a ***full operational evaluation***, which will likely include a *limited operational deployment* where modified force polices and training packages are implemented and evaluated and the *impact of operational use is assessed*. This provides vital information for an agency to make necessary adjustments before full deployment.

	Technology Readiness Level		Description
BASIC RESEARCH	1	Basic principles observed and reported	Lowest level of technology readiness. Scientific research begins to be translated into applied research and development.
PROVE FEASIBILITY	2	Technology concept and/or application formulated	Invention begins. Once basic principles are observed, practical applications can be invented. The application is speculative and there is no proof or detailed analysis to support the assumption.
TECHNOLOGY DEVELOPMENT	3	Analytical and experi-mental critical function and/or characteristic proof of concept	Active research and development is initiated. This includes analytical studies and laboratory studies to physically validate analytical predictions of separate elements of the technology. Bioeffects mechanisms clearly identified and verified.
	4	Component and/or breadboard validation in laboratory environment	Basic technological components are integrated to establish that the pieces will work together. This is "low fidelity" compared to the eventual system. Examples include integration of 'ad hoc' hardware in a laboratory. Safety risks/doses accepted. Effectiveness parameters (dose/ response) established.
TECHNOLOGY DEMONSTRATION	5	Component and/or breadboard validation in relevant environment	Fidelity of breadboard technology increases significantly. The basic technological components are integrated with reasonably realistic supporting elements so that the technology can be tested in a simulated environment. Safety margin between effectiveness and injury doses determined.
SYSTEM AND SUBSYSTEM DEVELOPMENT	6	System/subsystem model or prototype demonstration in a relevant environment	Representative model or prototype system, which is well beyond the breadboard tested for TRL 5, is tested in a relevant (high fidelity laboratory environment or in simulated operational) environment. Represents a major step up in a technology's demonstrated readiness. Prototype proven to be safe in lab/field environments.
	7	System prototype demonstrated in an operational environment	Prototype near or at planned operational system. Represents a major step up from TRL 6, requiring the demonstration of an actual system prototype in an operational environment.
SYSTEM TEST AND OPN	8	Actual pre-production system completed and qualified through operational test and demonstration	Technology has been proven to work in its final form and under expected conditions. In almost all cases, this TRL represents the end of true system development.
	9	Actual system proven through successful mission operations	Actual application of the technology in its final form and under mission conditions, such as those encountered in operational test and evaluation.

Technology Readiness Levels. An amalgamation of definitions from DoD and NASA.

Standards. Although there are a number of national and international efforts to provide reasonable standards, few standards currently exist in the realm of less-lethal devices. One of the difficulties is that these devices cross a number of technology domains. Another challenge is that, as opposed to lethal weapons which have to meet a single "effects threshold" of lethality, less-lethal devices have to operate within a "threshold window." In other words, less-lethal devices have two thresholds: they have to achieve a *minimum* threshold whereby some "effect of interest" can be demonstrated to fill some operational requirement and must also demonstrate that they do not exceed a *maximum* threshold of causing serious injury or death. Arguably, an additional challenge in the United States is that the federal government has no regulatory powers over the states except in matters specifically delineated in the U.S. Constitution (Doctrine of Sovereign Power – 10th Amendment). There is no regulatory agency in the U.S. Department of Justice that can impose less-lethal device standards, regulations or sanctions on local government. Consequently, while these standards might be binding to federal agencies, they would appear as recommendations to states and municipalities.

As innovative devices appear in the marketplace, there will be efforts to create standards to protect the "consumers." Historically, developing standards for less-lethal technologies has had mixed results. While some are apparent and easily defined, others have proven elusive and difficult to develop. For example, while impact munitions have been in use for decades, there are no standards for safety and effectiveness.

Standards come in a number of forms. There are standards for testing and measuring, which describe what should be measured, how such measurements should be made and under what circumstances. There are also product standards which establish whether or not a particular device or technology functions properly and is "ready for use."

Formal Standards. There are hundreds of bodies and authorities responsible for developing formal standards in the United States. The American National Standards Institute (ANSI) accredits standards bodies. To be eligible for ANSI accreditation, a standards body has to have an open process. The International Organization for Standardization (ISO) is the international version of ANSI. There are also treaty organizations that deal with standards.

Open Consortia. Open consortia are eligible for ANSI accreditation based on the openness of their configuration. They normally have broad membership and create standards for products or technologies of interest to the particular membership. The Internet Engineering Task Force, which develops standards for the Internet, is but one example of an open consortium.

Closed Consortia. This arrangement brings organizations or companies together for the specific purpose of writing a standard.

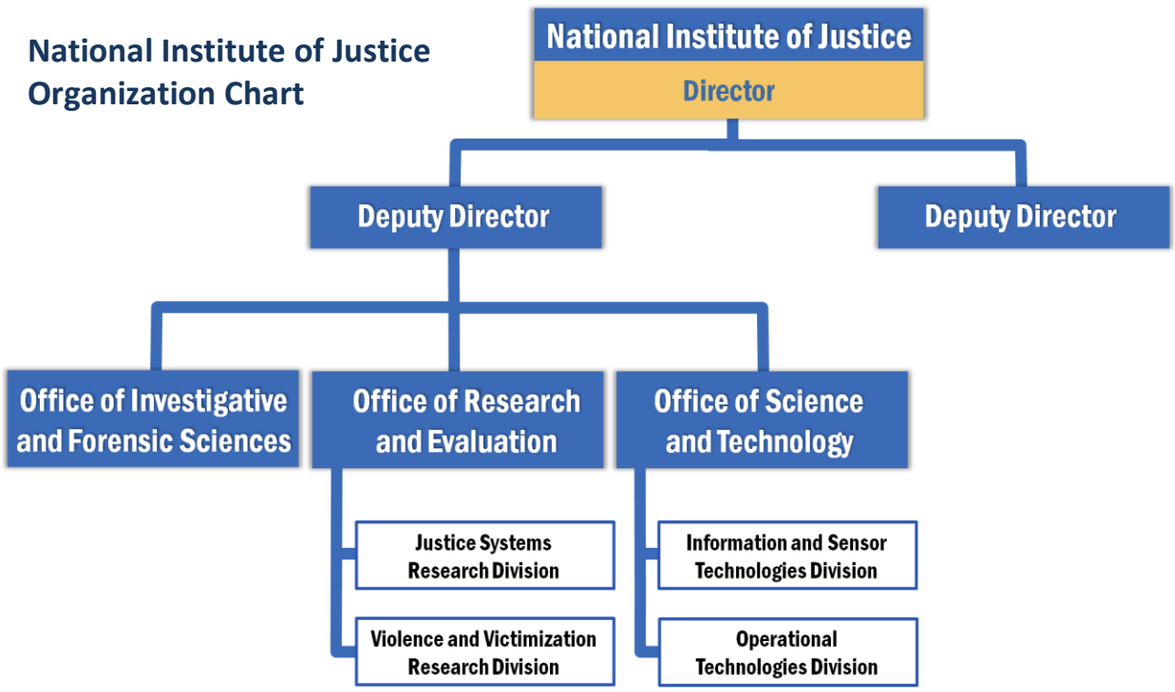
Informal Development. This type of standard evolves from interested parties and becomes a de facto standard. Individuals, associations, or manufacturers write a standard and, subsequently, others use it. These surfaced in the 1980s largely as an alternative to the standards developing organizations at that time whose processes were considered too burdensome and slow to respond to rapid technology innovation and growth. In some instances, this is a "standard by consensus," and not formally recognized. It has become the norm for many less-lethal options, given the absence of more formal standards.

The federal government role in standards has evolved over the years and now encourages adoption of open consensus standards as much as possible.[1] Procurement of commercial-off-the-shelf (COTS) technology is also encouraged by the federal government. However, recognizing that law enforcement and corrections agencies across the country often have no objective information on vendor products, the National Institute of Justice and the National Institute for Standards and Testing (NIST), through its Office of Law Enforcement Standards (OLES), have been cooperating to develop standards in a number of technology areas – including less-lethal devices.

Leveraging Federal Research

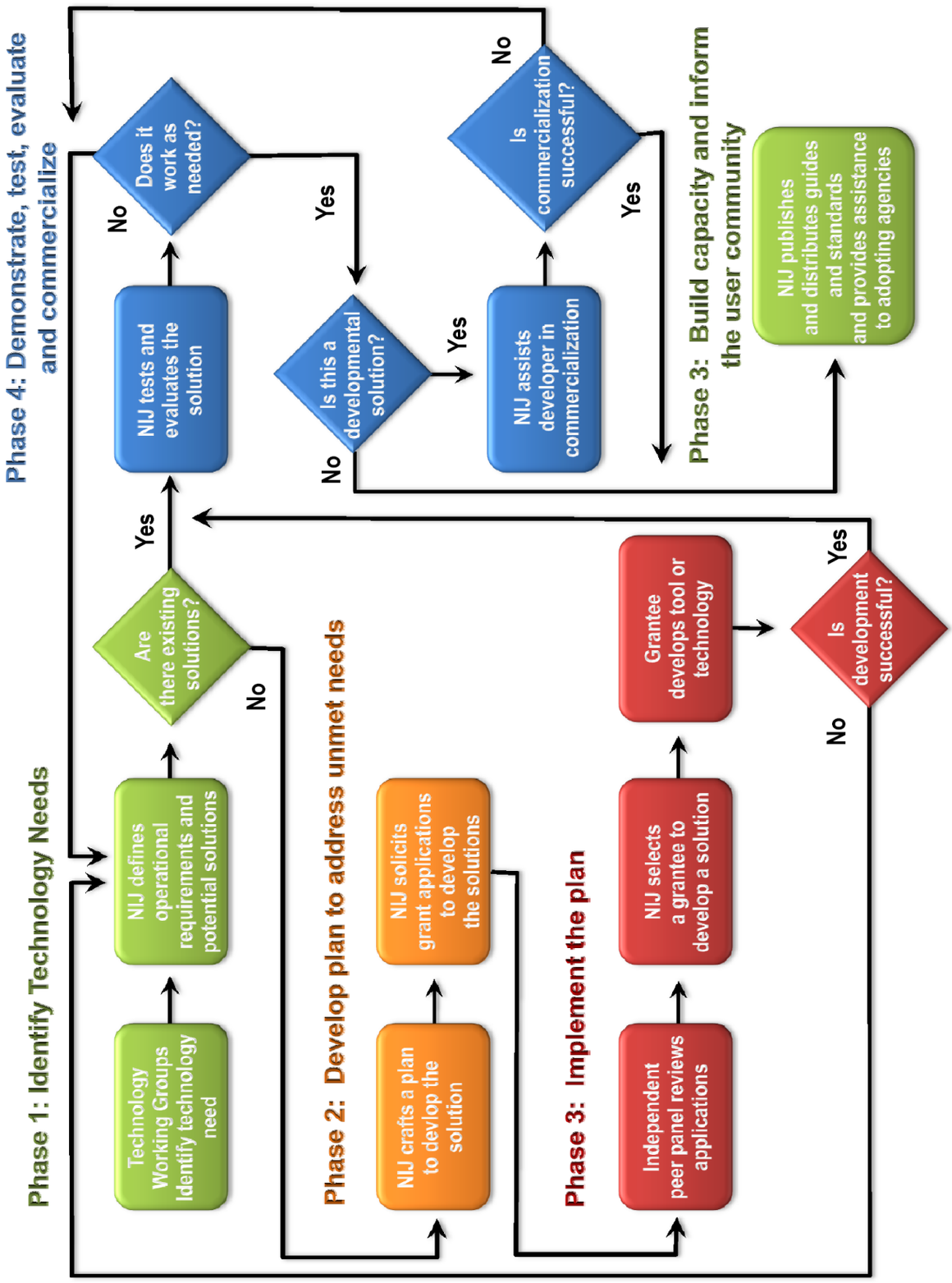
Department of Defense (DoD). The Joint Non-Lethal Weapons Directorate (JNLWD) is responsible for the management of DoD's Joint Non-Lethal Weapons Program and serves as the focal point for technical and programmatic guidance of current and projected technologies. Each of the military services also manages a program. Though the research and development conducted by DoD has a military focus, there are many common areas of operational interest. While many associated research reports have been limited in distribution in the past, there are efforts to make these available to both law enforcement and the general public.

Department of Justice. The National Institute of Justice (NIJ) is the research, development, and evaluation agency of the U.S. Department of Justice (DoJ). It provides objective, independent, evidence-based knowledge and tools to meet the challenges of crime and justice, particularly at the state and local levels.



The NIJ has three major research offices: **The Office of Investigate and Forensic Sciences**, **The Office of Research and Evaluation**, and the **Office of Science and Technology**. These latter two offices conduct and fund research in use-of-force and less-lethal technologies. The Office of Research and Evaluation (ORE) develops, conducts, directs, and supervises research and evaluation activities across a wide variety of issues. The Office of Science and Technology (OST) manages technology R&D, development of technical standards, testing, and technology assistance, and is the home of the NIJ Less-Lethal Program. In an effort to assist criminal justice activities identify and clearly articulate technology needs, which may be further supported by federal resources, the NIJ has formalized its RDT&E process within the OST. This process aligns NIJ's portfolios with the technology needs of the criminal justice community. The process has five phases:

- Determine technology needs;
- Develop technology program plans to address those needs;
- Develop solutions;
- Demonstrate, test, evaluate, and adopt solutions into practice;
- Build capacity and conduct outreach.



The Research, Development, Testing and Evaluation Process implemented by the Office of Science & Technology at the National Institute of Justice (US Department of Justice).

At the core of this process are a number of NIJ technology working groups (TWGs). The TWGs are operator-based committees of 15 to 30 experienced practitioners from local, state, tribal, and federal agencies and laboratories associated with a particular NIJ technology area.

The TWGs identify criminal justice technology needs within their specific focus area – which sometimes overlap. These needs are fed to the Law Enforcement and Corrections Technology Advisory Council (LECTAC) which then prioritizes those needs across all of the TWGs. This list is then used to determine which of the critical operationally-based technology needs will be allocated federal funding for research and development.

NIJ Technology Working Groups

- Aviation
- Biometrics
- Body Armor
- Communications
- Community Corrections
- Court Technologies
- DNA Forensics
- Electronic Crime
- Explosive Device Defeat
- General Forensics
- Geospatial Technologies
- Information-Led Policing
- Institutional Corrections
- ***Less-Lethal Technologies***
- Operations Research/ Modeling and Simulation
- Personal Protection Equipment
- Pursuit Management
- School Safety
- Sensors and Surveillance

TWG members also participate in peer-review panels that evaluate potential solutions to address practitioner needs. Agencies from which TWG members are drawn are routinely involved in testing and evaluating the resulting solutions. The TWGs, and through them the criminal justice practitioner community, are embedded in the NIJ RDT&E process from beginning to end.

Much of the research and testing conducted (and/or funded) by NIJ results in reports that are available through the NIJ website or at one of its related outreach sites.

Chapter 3 Endnotes:

[1] Information Technology Management Reform Act of 1996 (ITMRA).

4 OVERVIEW OF TECHNOLOGIES

Less-lethal devices can be categorized any number of ways. This guide uses technology categories to discuss current and emerging devices available to law enforcement. These devices are designed specifically to be less-lethal, if deployed in a manner consistent with manufacturer specifications and in accordance with established use-of-force policies by properly trained operators. Nonetheless, situational context can change quickly and suspect responses are often unpredictable. Although monitored by departmental and community oversight mechanisms, misuse can also occur. Any device, if not used properly for its intended purpose, can be lethal – even a pencil. For purposes of this guide, we have categorized these devices in the following manner:

- Mechanical & Kinetic Devices
- Diversionary Devices
- Conducted Energy Devices
- Riot Control Agents
- Directed Energy Devices
- Barriers & Entanglements

Mechanical & Kinetic Devices

Kinetic less-lethal weapons are used every day by civilian police authorities throughout the United States. When a police officer uses a baton or fist to prevent someone from doing something, a kinetic less-lethal device has been used. These weapons can also take the form of hundreds of tiny rubber balls raining down on a crowd or a bean-bag round striking a rioter's thigh. Since one might not readily perceive that all of these weapons fall within the same category, for the purposes of this guide, we need a common definition of kinetic less-lethal weapons.

Kinetic less-lethal weapons are intended not to kill, but to influence the behavior of a subject (compliance) by introducing physical discomfort or pain through blunt impact of the device. The level of trauma and pain caused by less-lethal weapons should be relatively short-lived and reversible. Preferably, the targeted individuals will not require medical attention and will be able to recover on their own. Kinetic less-lethal weapons are the oldest and most prevalent of all less-lethal devices. Although more sophisticated less-lethal technologies are available and loom on the horizon, kinetic weapons remain the most common largely due to their simplicity, low cost, and adaptability to existing launch platforms.

Batons. Other than body parts, like fists, the oldest less-lethal kinetic weapon is the baton. The message of a wielded baton is universally identifiable – if one does not comply, pain could ensue. At the same time, the baton communicates that the user does not desire to kill the subject.

These weapons come in many different lengths, construction materials, widths, and designs (straight, side-handle, and hybrid). Longer batons help to keep unruly crowds at a greater distance and work well with shields, whereas shorter batons are designed for close-range, one-on-one application. Many batons can collapse to a shorter length for ease of carrying or concealment. Some have metal balls on one end for greater effect. Some are designed to spin, so as to move faster than a traditional baton and, therefore, impart more kinetic energy to the target. Duty batons are made of polycarbonate, rubber, wood, or aluminum. There are also practice batons, made of foam-like materials, for training purposes only. They are usually a different color so as not to be confused with duty batons. Some come with well-documented training schemes and manufacturer support – others do not. Some have item-specific carrying devices, while others simply use a ring as carrier.[1]

Water Cannon. Water, when applied through a water cannon or high-pressure hose, is considered a kinetic less-lethal weapon. Water cannon have been a staple in foreign countries for crowd control and have seen some use in the United States. Some use these systems to

address civil disorder. Some water cannon are mounted on vehicles. Back-mounted units are now emerging in the market. Sometimes an agency will simply borrow local fire department equipment. On a cold day, misting the crowd can bring an uncomfortable chill and dissuade many from unlawful behavior. However, the image of police hosing down civil-rights protesters in the 1960s has caused many police departments in the U.S. to abandon these systems entirely.[2]

Water Cannon
New York City Police Department (NYPD)
Disorder Control Unit (DCU)

SOURCE: RK Chin

Launch Platforms. Some launchers are designed specifically for use with a particular impact (kinetic) munition. There are also launch platforms which accommodate both lethal and less-lethal munitions. Using these platforms can reduce training time, reduce expense, and lighten the load of the officer on the street. Law enforcement usually bases this decision on three considerations: *need*, *safety,* and *cost*. The greatest safety concern is that of mistaking a lethal round for a less-lethal round, leading to unintended and fatal consequences. In order to reduce this risk, many police departments now require bold, identifiable markings on less-lethal launch platforms and prohibit them from contact with lethal ammunition. Some view this visible distinction (which allows the subject to identify the type of weapon being used) as a disadvantage – some view it as an advantage, since presenting such a profile has more community acceptability. However, most view it as necessary. Many police associations, including the National Tactical Officers Association (NTOA), view mixing lethal and less-lethal munitions and delivery systems as inherently problematic. The challenges in training officers to function under stress in volatile, uncertain, complex, and ambiguous environments with the same weapon in what are intended to be significantly different operational modes cannot be overstated. Strong consideration should be given to creating procedural and physical safeguards (orange or yellow paint/markings).

- *Grenade or Riot Control Launcher (37/40mm).* The 37mm launcher was originally designed to launch flares and lethal grenades. Less-lethal munitions were subsequently designed to be launched with the platform. During World War II, a 40mm weapon caliber was conceived and has since been the standard for countries of the North Atlantic Treaty Organization (NATO). Civilian police bought surplus 37mm launchers from the military in North America and Europe. There are now both 37mm and 40mm less-lethal kinetic rounds available.[3] Generally, 37mm launchers are smooth bore and 40mm are rifled. The 40mm uses cartridges that are 4, 4.8, 5, or 8 inches in length. [4] Some can carry multiple rounds and others are single-shot only. Multiple-round launchers can get more less-lethal rounds on target faster, as less time is spent reloading. However, when it does come time to reload, it takes more time than loading a single shot launcher.

M79 GRENADE LAUNCHER (40mm SINGLE)

Penn Arms TL-1 (40mm SINGLE)

Penn Arms PGL-65 (40mm MULTI)

M203A1 UNDER M4A1 CARBINE (40mm SINGLE)

- *Shotgun.* Typically, police use 12-gauge, pump-action shotguns. The pump-action works well with less-lethal rounds. Some departments are integrating semi-auto shotguns into their arsenals. These do not generally work well with less-lethal rounds as they do not cycle the action dependably. Bean-bag rounds, for example, have a tendency to get blocked by the choke of the barrel and require a "cylinder choke" to function properly. Some shotguns have rifled bores (causing the round to spin, which can improve accuracy), and some do not. Many departments designate (and color-code) specific shotguns for less-lethal munitions.[5]

- *ARWEN.* The Anti-Riot Weapon Enfield (ARWEN), manufactured by the Royal Small Arms Factory of Enfield, uses a 37mm launch platform and has a five-shot capacity. It can launch four-inch plastic baton rounds up to 100 meters. The United Kingdom adopted Enfield for use in the late 1970s. The Los Angeles County Sheriff's Department adopted the ARWEN in 1985, just in time for a jail uprising in the city's Central Jail facility in 1986. The Los Angeles Police Department used ARWEN during the 1992 riots. In the late 1990s, ARWEN ceased production of their launchers and batons. Many U.S. police departments and correction facilities still have some of these launchers in use.[6]

The ARWEN 37mm barrel is rifled, causing the baton to rotate as it exits the barrel (spin-stabilized baton rounds). Many agencies were left with no parts for the launchers or batons for training and operational use when ARWE ceased production. Sage Control Ordnance developed a segmented baton to fill the void left by ARWEN. Later, Penn Arms manufactured the 37mm rifled barrel launcher to replace the aging ARWEN launchers that were being deployed across the U.S. and Canada.

An rotating band provides forward obturation (seal required to develop pressure inside the barrel). When the weapon is fired, the rotating band contacts the rifling and is pressed between them. As the projectile travels the length of the barrel over the lands and grooves of the rifling, spin is imparted. The rifling in the barrel scores the rotating bands. The replaceable rotating bands allow for repeated use in training. After repeated use the rotating bands can be replaced for consistent accuracy.

As of the publication date of this Guidebook, ARWEN is back in the business of manufacturing less-lethal launchers and batons. There are differences in the composition of the batons as well as the launchers themselves as compared to the Sage Control Ordnance products. Sage Control Ordnance produces a wide range of munitions (including the 40mm family of projectiles) and has dominated the 37mm rifled barrel market in the United States since the early 1990s.

Impact Munitions. Impact munitions vary in size, weight, material properties, and construction. They are configured as rubber balls and batons of wood, rubber, and foam. Some use cloth bags of powdered lead and silicon. They may have flat or round noses. They may tumble, be stabilized, or have purely ballistic trajectories. A single munition may contain one or multiple sub-munitions. The design and properties of the projectile nose (and similarly the characteristics of the targeted subject) will influence how the projectile deforms on impact and thus how the force (pressure) attenuates over time. These properties and innumerable contextual variables relate to operational effectiveness and injury potential. As with launch platforms, it is important to have a method to distinguish between lethal and less-lethal rounds. The coding schemes used are normally tactile or visual in nature. Some rounds use color or writing on their casings; however, it is difficult to read writing or distinguish colors in low light conditions. Some manufacturers use raised letters that glow in low light, however, the letters tend to wear away the more they are carried. Other manufacturers use raised ridges on the nose of the round. Some less-lethal rounds can be distinguished by feel, such as the nose of a foam round. Whatever method is used to distinguish a particular munition, be sure to set up a procedural and physical method of confirming whether a round is less-lethal or lethal.

SOURCE: INLDT Photos

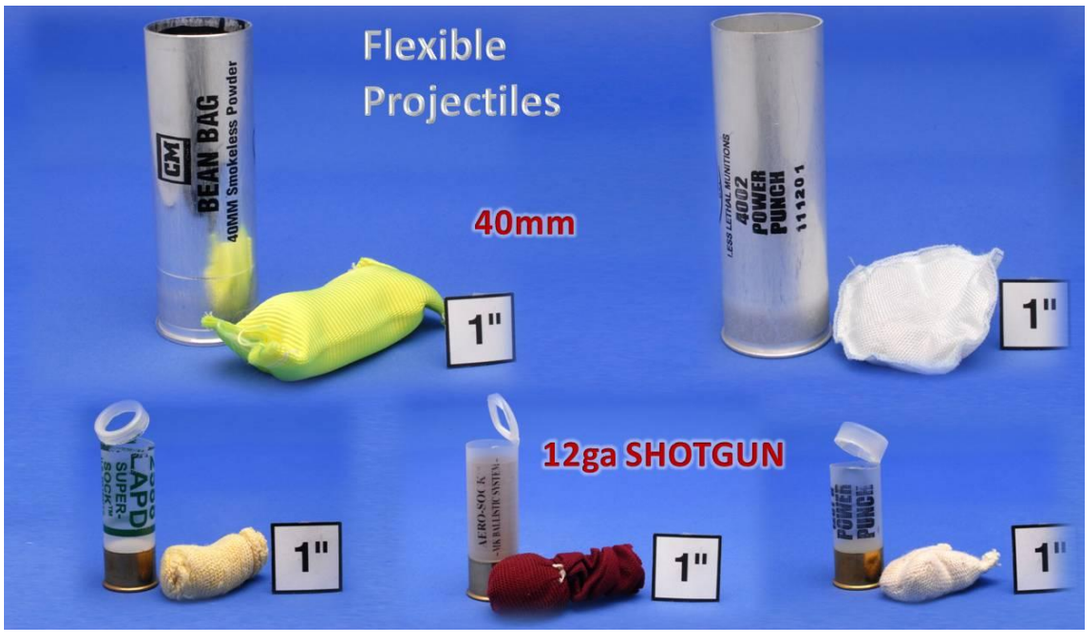
- *Rubber Balls and Pellets.* Rubber balls and pellets come in various categories: single, multiple large (diameter >½ inch), and multiple small (diameter <½ inch). The multiple-projectile variety employs small shot-like pellets similar to their lethal buckshot counterpart. Single-projectile munitions are more discriminating and are normally fired directly at a subject, while the multiple-pellet rounds can be fired either directly or by skipping off hard surfaces immediately in front of subjects. These projectiles are most commonly manufactured from rubber or PVC of varying degrees of hardness and can be launched from shotguns or grenade launchers.[7]

SOURCE: INLDT Photos

- *Baton Rounds.* These rounds are generally small cylinders made of foam, plastic, rubber, Styrofoam, or wood. A newer variant is the sponge grenade. Short and thick, they rely on extended-range impact for effectiveness. Baton rounds can contain single or multiple projectiles. They are intended mostly for direct-fire, although some manufacturers still sell munitions specifically designed for “skip-firing.” The greatest variety of cartridges is available for 37/40mm configurations in lengths ranging from five to eight inches. Some baton varieties are available for 12ga shotguns.

SOURCE: INLDT Photos

- *Flexible Projectiles*. These projectiles employ a pouch or pad containing a heavier material. The pouches are commonly made of a ballistic nylon or similar high-strength, resilient material with silica, lead, or steel shot sewn inside. The pads may be round, rectangular, or square and are folded longitudinally inside a shell casing. After launching, the pads are intended to open in flight and strike an adversary with one of the large flat sides. These munitions are available for shotguns, 37mm (smooth/rifled bore) launchers, and 40mm (rifled bore) launchers. Some projectiles of this variety are saturated with a colored dust or chemical agent to aid in identifying an adversary.



SOURCE: INLDT Photos

The square and rectangular variety developed a reputation for unpredictability in flight (Frisbee or sailing effect) and unanticipated injury if the projectile did not fully unfurl or struck a person with its edges rather than its sides. The square-design 12ga shotgun rounds have been discontinued due to their inherent inaccuracy leading to potential serious injury.

- *Drag Ribbon Stabilized Projectiles.* These are padded projectiles, foam batons, and rubber batons that employ drag ribbons for stabilization. They often use a flexible tail (ribbon of varying length, width, and thickness) to induce drag (deceleration) and provide more stability in flight (i.e., prevent tumbling and sailing effects). The drag forces on the ribbons apply a net moment about the center of gravity of the projectile (sock, flexible baton, baton) which tends to restore the projectile to a zero angle of attack. The intent is to provide a greater probability that the munition will impact with the optimal orientation. The flexible projectiles commonly use an open-ended, single fabric container filled with lead shot that is tied, sewn, or crimped to seal the shot in one end. The remainder of the material is either left loose or cut into individual tails, which vary in length from one to several inches. Since many of these munitions employ a single fabric container that resembles a stocking or sock, they are often referred to as "sock" rounds. [8]

SOURCE: INLDT Photos

- *Fin-stabilized Projectiles.* These projectiles employ rigid or semi-rigid vanes or fins to stabilize the projectile (prevent it from tumbling). They are normally made of a single material (rubber/polyurethane). The front portion of these projectiles is cylindrical or "tear-drop" in shape with either a flat or blunt nose.

SOURCE: INLDT Photos

- *Encapsulated Projectiles.* These projectiles typically contain a liquid or powder material with a membrane, protective coating, or shell. They are designed to disperse the contents on impact. In fact, some strike only hard enough to release an agent and would not otherwise qualify as an impact munition when compared to the conventional baton or pellet rounds. Others are intended to cause pain, but are designed to release excess energy by bursting to reduce the probability of penetration. Some encapsulated rounds contain marking dyes for marking an object or person from a distance. Most of these munitions require a specific, even proprietary, launch platform.[9]

Tactical Aim Points (TAPs). Launched high energy impact projectiles are intended to incapacitate an individual by generating blunt force trauma and pain resulting in voluntary compliance. While the intent of these impact projectiles is not to cause serious injury or death, there is a potential to do so. It is important that the operator understand the dynamics of blunt force caused by their specific projectile.

Many projectiles have similar kinetic energy values (the relationship between the mass and the velocity of the projectile in motion). But projectiles with similar kinetic energy values at impact may differ significantly in effectiveness and injury potential due to dissimilarities in shape, size, and material properties (pliancy). Additionally, the operator must select points on the human body to target, given a number of

variables. The appropriate Tactical Aim Point is based on, but not limited to the seriousness of the crime; the level of resistance (and force policy); the body mass of the suspect; environmental conditions; distance (range to targeted subject); and characteristics of the projectile.

In one instance the Tactical Aim Point might be at a lower extremity to minimize serious injury potential. If the situation escalates the operator might select a lower abdomen target for faster incapacitation for example-but that raises the risk for serious injury. The selection of a Tactical Aim Point is intended to be a measured or commensurate response to the threat by an individual. Each situation is factually dependent and contextually unique. There is no single proscriptive target zone appropriate for all projectiles universally.

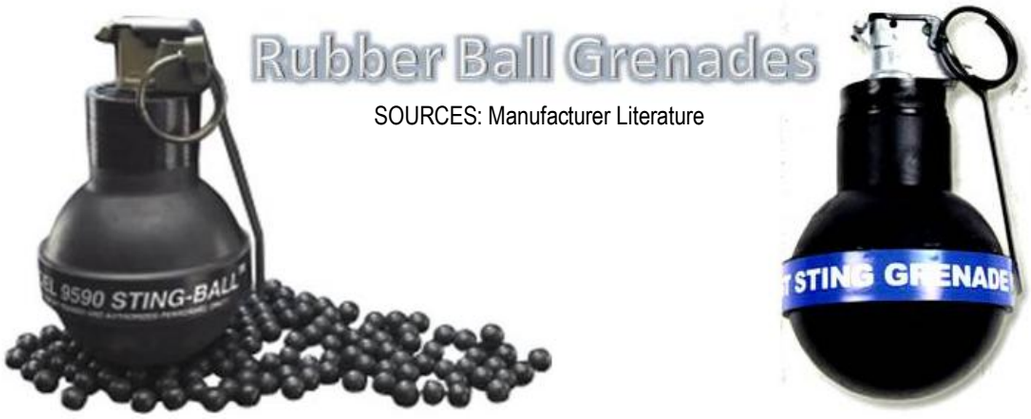
Diversionary Devices

Diversionary devices are used to distract individuals, disorient individuals or small groups, impose tactical deception, and/or temporarily disrupt activity. They are deployed to gain a temporary tactical advantage. The window of opportunity to exploit this tactical advantage is normally very short in duration. Whenever practical and barring unforeseen or extraordinary circumstances, these devices should be sight-delivered – including when used in conjunction with extension devices (often called “bang poles”).

Flash/Sound Diversionary Devices (FSDD). These devices create a bright flash of light and a loud report that is intended to distract an individual. Their intended purpose is to create a diversion allowing tactical teams a temporary tactical advantage. The window of opportunity to exploit this tactical advantage is normally very short in duration. FSDDs generally use a variety of flash powder consisting of aluminum or magnesium powder and an oxidizer such as barium nitrate or potassium perchlorate. This is similar to the flash powder used in theatrical pyrotechnics, fireworks, and firecrackers. Non-bursting FSDDs have a casing made of heavy metal which remains intact during deflagration.

The charge is located inside the casing. Venting holes in the casing allow the escape of hot gases and light without fragmentation. No alterations or manipulations of FSDDs should be made as this creates dangerous conditions.

Rubber Ball Grenades. Once the safety pin has been removed the grenade is ready to be deployed. Once thrown, the spoon is released and, after a delay, the fuse detonates the grenade expelling approximately one hundred .25 caliber rubber balls from the grenade in a circular pattern out to about fifty feet. The rubber balls leave the grenade at about 700 feet per second. Some rubber ball grenades have OC or CS payloads to be dispersed with the rubber balls. Considerations include location of fellow officers with respect to the thrown grenade and the vulnerability of eyes. Additionally, a launched rubber ball grenade will often have a fuze assembly that ejects in a largely unpredictable manner.[10]



Flash/Sound Diversionary Devices (FSDDs) and rubber ball grenades are considered destructive devices by the Bureau of Alcohol, Tobacco, Firearms, and Explosives (ATF), due to their flash powder content. As such, transfer and storage of these devices in official police response vehicles are strictly regulated. ATF Ruling 2012-4 provides for certain exemptions to storage requirements normally located in the Code of Federal Regulations. Other munitions containing flash powder fuzes, known as Explosive Attenuated Tactical Devices (i.e., riot control agents, smoke, and irritant grenades) are also subject to the storage regulations in ATF Ruling 2012-4. To access more information contact the ATF Explosives Industry Programs Branch, your local ATF Field Office, or the National Tactical Officers Association.

Warning Munitions. These devices are designed to create a bright flash of light, a loud report, and a visible smoke signature. Some function at the muzzle and others function at a distance and altitude downrange.

Warning munitions are largely used in maritime force protection as a warning to approaching vessels and in maritime law enforcement as an interdiction tool to halt fleeing vessels. Munitions are available and/or under development in 12-gauge and 40mm.

Conducted Energy Devices

This family of devices relies on extremely low electrical current to achieve compliance from targeted subjects. There are two effects of interest. The first is **pain** induced by electrical shock when the contacts (positive and negative) of the device are very close (normally less than four inches). This pain can produce compliance of a subject or sufficient distraction to enable an officer to disengage or use hand control techniques. As with any pain compliance tool, it is less effective against disturbed persons or those under the influence of alcohol or drugs.

SOURCES: Manufacturer Literature and INLDT Photos

The second effect of interest is **extreme (but temporary) muscle tetany** – involuntary muscle convulsion. At the high frequencies (pulse repetition rates) of most of these devices (nominally 16-19 pulses per second), the muscle contractions appear as one smooth contraction. Unlike the "pain" effect, this muscle tetany appears to be universal across the human population in its effect. There are differences in *how well* particular devices achieve this tetany, however.

Since 1996, the proliferation of these devices has lead to increased scrutiny and examination of the technology. The Departments of Justice and Defense conduct continuing work on the mechanisms of action, "effects of interest," and injury potential which still lack clarity.

The growing array of devices entering the market complicates matters. There are three major operating modes for this family of devices: **drive stun**, **tethered probes**, and **launched**. Some devices operate in only one mode and others can operate in more than one mode and have been incorporated into riot shields, transport belts and restraints.

Drive Stun. Stun guns largely operate in the single mode of drive stun. They are designed to be held, triggered, and pushed into a subject so that two or more conductors make contact and deliver a low current. Generally, the drive-stun or contact mode will cause pain and discomfort, but not muscle tetany.

Tethered Probes. There are a number of devices on the market that use tethered probes ejected from cartridges. The thin wire tethers deliver the current to barbed probes. Many researchers now believe that this separation distance between the probes allows the electrical current to stimulate sensory nerves and generate a spinal response that is perceived as muscle tetany.

Launched. This is an area that grew out of the law enforcement and military operational requirement to achieve greater distances with CEDs. There are few that have reached the market, but much research and development continues. The approaches vary, but all include projectiles with self-contained electronics and power supplies and seem to leverage existing electrical waveforms of known effectiveness. As these rounds are self-contained and not reusable, cost per unit (and per shot) may be the major factor in their broad deployment. Since the first edition of this Guidebook, TASER International has discontinued the sale of the XREP to U.S. law enforcement. No other launched (non-tethered) CEDs are commercially available at this printing.

Riot Control Agents

The predominant agents used in law enforcement and corrections are normally referred to as Riot Control Agents (RCAs) – despite the fact that they have much broader tactical application for law enforcement than crowd management and riot control. Internationally, RCAs are defined as:

> Any chemical not listed in a Schedule [lists of chemicals prohibited under the Chemical Weapons Convention] which can produce rapidly in humans sensory irritation or disabling physical effects which disappear within a short time following termination of exposure.[11] [emphasis added]

Recognizing the important distinction between warfare and domestic law enforcement, the international community has also acknowledged more broadly that use of chemicals for "law enforcement including [but not exclusively] domestic riot control purposes" is not prohibited.[12]

Riot control agents are useful in many law enforcement contexts. They deliver pain and discomfort to individuals and rarely leave subjects with negative symptoms after having been decontaminated. RCAs are great force multipliers in that they can be used by a single officer against one or a number of subjects. RCAs can be used to saturate areas such as attics and basements that can be hazardous when shielding suspects. They can also be used to deny the use of an area to a person such as multiple rooms of a house in which a gunman is barricaded.

Some of the possible tactical roles that RCAs support across a number of operational scenarios include:

- **Distraction (individual)**
- **Deception (tactical)**
- **Disruption (activity)**
- **Dispersal (crowd)**
- **Disorientation (individual/group)**
- **Disablement (individual/group)**
- **Denial (area/vehicle/facility)**

RCAs and their formulas, applications, and methods of deployment are constantly being reexamined. This guide covers those agents that are in common use or may remain in inventories. In this regard, RCAs fall into one (or more) of the following five *technology categories*:

CATEGORY	DESCRIPTION
Malodorant Agents	Substances causing persistent and obnoxious odors applied to individuals or objects
Irritant Agents	Substances that produce a temporary but irritating and often painful sensation to the skin and/or mucous membranes
Smoke	Largely white or colored and used to degrade observation or identify locations on the ground
Marking Agents	These paints, dyes, and pigments may be standard or fluorescent and can be delivered by spray, stream, projectile, or other means
Calmative Agents	This emerging area leverages substances that produce a calming state in subjects to allow for controlled conflict resolution

Malodorant Agents. These agents are designed to smell extremely bad in minute concentrations. Malodorants, like skunk scent or dead fish, can be used to mark people or to persuade them to leave an area. They can also be used to dissuade people from congregating in areas or buildings. The foul-smelling compounds can be sprayed from truck-mounted cannons or from backpacks carried by police officers. Some formulae are made entirely from natural organic ingredients.[13]

Irritant Agents. These agents are inflammatories and lacrimators that cause transient discomfort and eye closure. Law enforcement agencies use them for situations like clearing buildings and riot control. They require an extremely high concentration to be lethal and a very low concentration to be effective, so they have a high safety ratio. Their major purpose is to cause pain, burning, or discomfort on exposed mucous membranes and skin. These effects occur within a few seconds of exposure, but rarely persist more than tens of minutes after exposure has ended.

- *Oleoresin Capsicum (OC).* Commonly called pepper spray, OC is derived from Capsicum plants, which include chili peppers, red peppers, jalapeno peppers, and paprika, but not black pepper. The capsicums are hardy and adaptable, sometimes developing new characteristics of shape, color, size, and pungency. The strength of OC depends on the type and quality of peppers (including the conditions of a particular growing season), not necessarily the number of peppers used. The active compounds – capsaicinoids –

are a group of alkaloids naturally occurring within the fats, oils, and waxes of the pepper plant. The amount of these compounds in a substance determines its heat intensity (i.e., potency).[14] The primary capsaicinoids found in OC products include **capsaicin**, **dihydro-capsaicin**, and **nordihydrocapsaicin**.

To counter the naturally occurring variation in pungency of peppers, synthetic products have been developed in order to control the specific concentration and achieve a consistency of effect. **Pelargonic Acid Vanillylamide** (PAVA) spray is dispensed from a hand-held canister in a liquid stream that contains a 0.3% solution of PAVA in a solvent of aqueous ethanol. The propellant is nitrogen. Captor is another form using **nonivamide** as the active ingredient (also a Capsaicinoid). The formula for preparing Captor can be precisely controlled with each batch.[15] Evaluations of this synthetic are still being conducted. PepperBall Technologies uses a powder formula PAVA in their encapsulated projectiles.[16] The percentage of PAVA ranges from 0.7% to 10% with inert carriers to better separate and disperse the powder upon impact.

OC delivery is usually expressed in terms of four types of spray modalities. First is a ***fog***, also known as a mist or cone. This delivery uses the smallest particle size but is less precise than the other two modalities. Second is the ***stream*** (or ballistic stream), which contains larger particles in its mixture. Streams are more accurate than fogs and less influenced by air movement. Streams are best applied to a subject's eyes in a side-to-side movement.[17] ***Foams/gels*** have the most concentrated particle level and have a better adhesive quality than other modalities. Foam is best used in environments where cross-contamination is a concern such as a courtroom, hospital, or prison cell. OC can also be applied in a ***powdered form*** delivered in encapsulated kinetic rounds or fired as a dust directly from a large bore muzzle (sometimes referred to as called “muzzle dusters”). [18]

Officers use OC in a stream form to gain compliance

SOURCE: Matt Rourke | AP Photo

- *Ortho Chlorobenzalmalononitrile (CS).* Known as CS due to its invention in 1928 by two chemists named Ben Corson and Roger Stoughton, this agent is designed to cause a burning sensation to all of the moist areas of the body. Long exposures may cause vomiting, nausea, and skin blistering. It causes an individual to close his or her eyes and gives the individual a sensation of suffocation.

SOURCE: Internet; Origin unknown

Officers use CS as a tool to disperse a non-compliant crowd

CS is typically used to dislodge barricaded subjects or to disperse unruly crowds. Cross-contamination with uses of CS is high as its potency is longer-lasting in the contaminated area. However, no deaths have been reported as a result of its use. CS normally takes effect on human targets within 20 seconds. Post incident decontamination is a concern. Use of CS in an apartment house or hotel may very well affect the entire structure. Decontamination of such a structure may be costly and time consuming. Decontamination for people is simply exposure to clean air and sometimes cold water. Fifteen minutes without contamination usually relieves all but the most severe symptoms even without deliberate decontamination measures.

- *Chloroacetophenone (CN).* Sometimes referred to as Mace, CN is an agent that has been used significantly less over the past two decades as a primary riot control agent. It has been largely replaced by CS and OC as these agents disperse more quickly and have a more rapid onset than CN. However, it is still found in some hybrid OC mixtures and sometimes as a training tool.[19]
- *Diphenylarenamine (DM).* This substance is no longer commonly used in the United States, though it is believed that unused quantities remain in storage. Also known as Adamsite, DM is more toxic than CN, CS and OC. It is an irritant at low concentrations and a nausea-producing/vomiting agent at higher concentrations. It has thus been widely discontinued.

Smoke. Hexachlorethane (HC) or "smoke" is a counter-personnel tool as well as a counter-material tool. It can affect visual tools and mechanisms as well as human eyes. Smoke is used to obscure or screen friendly movement and as a means of deception. It is also used for tactical signals and to mark medical evacuation points and other locations. Smoke is a pyrotechnic agent. As such, it uses oxygen at a high rate and displaces oxygen in confined spaces. It is responsible for causing more deaths than any of the other agent-based tools. Smoke comes in various colors and burn rates. Its universal color code is yellow.[20]

Marking Agents. These are largely paints or dies delivered to a target by projectile or other means. They may be bright colors or fluorescent. They are used in training and as a means to mark an individual at a distance in order to later identify and arrest them. Although not widely available, some marking agents may also contain taggants – unique particles traceable to a specific device (munition serial number).

Calmative Agents. Calmatives are agents that have relaxing or pacifying properties in humans – sedatives. Though use has been limited around the world, calmatives appear to be an area of ongoing development both domestically and internationally for law enforcement. The most well-known use of calmatives was, perhaps, by the Russians at the Dubrovka Theater in Moscow to retake a theater full of innocents held hostage by Chechen terrorists. The “effect of interest” is the ability to place everyone in a situation into an unconscious state and allow the situation to be resolved in a controlled manner. Arguably, calmatives promise to be effective in handling crisis situations. There are challenges that remain including delivery mechanisms, dose safety, and after care. They will undoubtedly remain controversial as have many other less-lethal technologies.

Russian television shows Chechen terrorists after raiding the Dubrovka Theater in Moscow and taking 850 hostages in late October of 2002

SOURCE: Russian television news video image

Directed Energy Devices

Although technically kinetic devices deposit energy (blunt force) on a target to achieve some effect (pain), this guide limits directed energy systems to those that emit energy in an aimed direction without the means of a projectile or other physical object. These systems transfer energy to a subject for a desired effect.

Some believe that the future of less-lethal devices may lie with directed energy systems. The use of relatively unsophisticated directed energy technologies such LASER dazzlers, high powered flashlights, and acoustic hailing devices (AHDs) are becoming more common in police departments and correctional facilities. Many emerging and more advanced technologies remain in developmental and prototype stages within military programs.

Directed energy systems are differentiated by the type of energy created, the method of energy generation, and the power of that energy. Advancements in technology, materials, and miniaturization have made many of these directed energy systems possible. Directed energy systems are revolutionary because of their engagement characteristics. They can engage at the speed of light, and some have the potential to engage targets hundreds of miles away.

LASERs. The term "LASER" is familiar to nearly everyone. It is an acronym for Light Amplification by Stimulated Emission of Radiation. High-energy LASERs (HELs) can produce enough energy and/or power to burn or melt material. If directed at humans, high-energy LASERs can be lethal. The military envisions the use of these LASERs to reduce or eliminate collateral damage (less-lethal role) when it is necessary to attack a protected material target. Low-Energy LASERs (LELs) radiate directionally and are frequently intended to impair human vision or used in LASER sights, target acquisition devices, and range-finding equipment. Depending upon the frequency, power, and range, LASERs of this type can damage the cornea and retina.[21]

LASER Dazzlers. LASER dazzlers impair the vision of targeted subjects, normally at some stand-off distance. They may also be fully functional in very bright ambient conditions such as a clear sunny day. Dazzlers are primarily used as warning devices and to assist in discerning intent.

There are a variety of models including handheld devices resembling flashlights and rifle-mounted models (Picatinny rail and scope versions).

Visible LASER. A green or red LASER sight can also be used to visibly designate a threatening individual. The subject's reaction to visible illumination can help determine their intent.

Millimeter Wave Systems. These systems are often referred to as Active Denial Technology (ADT), as the first system was called the Active Denial System (ADS). It used a millimeter-wave technology developed by the Air Force Research Laboratory. Such systems use a transmitter that produces energy at a frequency of 95 Gigahertz (GHz).

Active denial system (ADS) mounted on a HMMWV

SOURCE: DoD JNLWD

The ADS antenna projects a focused or collimated energy beam. This beam deposits energy on targeted individuals, which produces pain and causes a reflexive response to escape the beam. The energy penetrates less than 1/64th of an inch into human skin, which is enough to stimulate pain sensors into feeling severe pain but without injury. [22]

A number of successive prototypes have been developed by the Department of Defense. These devices were engineered to reduce the size and cost of the system, while using the same technology to create the energy. The tradeoff was that the reduction in antenna size yielded a corresponding reduction in power output. Alternatively, the Department of Justice is focusing on size and cost reduction through solid state technology. These systems hold some promise for a wide variety of law enforcement and corrections applications.

Silent Guardian system based on active denial technology

SOURCE: Raytheon Company

Low power version of the active denial system (ADS) technology

SOURCE: Raytheon Company

High Powered Microwaves. Another area under development is the use of High Powered Microwaves (HPM) to stop vehicles by temporarily or permanently disrupting the electronic systems and microcircuits that control critical engine functions.

Sound. A more common use of directed energy technology is the use of sound. Whether simple loudspeaker systems or more complex acoustic hailing devices, sound generating devices have seen extensive use in military and police operational settings. Sound travels (or propagates) through all forms of matter (gases, liquids, solids, and plasmas). The matter that supports the sound is called the medium. Sound cannot travel through a vacuum. During propagation, sound waves are reflected, refracted, and attenuated (a gradual loss in intensity) by the medium and when encountering a new medium. Thus these devices can produce decidedly different effects in an urban canyon of a major metropolitan area than in a more open or rural setting. Sound can be divided into three frequency ranges:

- *Ultrasound* is higher in frequency than 20,000 Hertz (Hz), or cycles per second, the normal upper limit of human hearing;
- *Audible Sound* is normally between 20 Hz and 20,000 Hz;
- *Infrasound* is lower in frequency than 20 Hz the normal lower limit of human hearing.

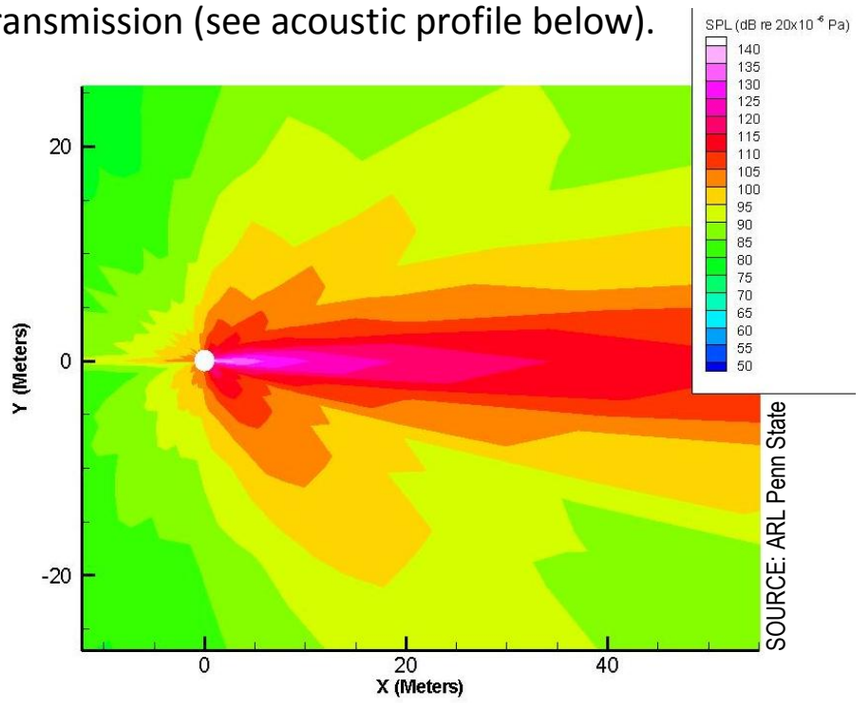
Ultrasound has not proven to have much use as a less-lethal device since it can be easily blocked or defeated. It is used frequently in the medical field. It can be very accurately aimed.

Audible Sound has been used in public address systems for information dissemination and as a means to annoy belligerents for decades. While not as precise as ultrasound, audible sound can be directed at a subject. Less-lethal devices in this realm are generally used for area denial, facility security, in public order situations, and as warning systems. Depending upon the range of sound, the duration of exposure, and the power level of the device, possible effects of audible sound when used as a less-lethal device include:

- Degradation of the subject's ability to perform tasks;
- Interference with hearing;
- Headaches;[23]

Infrasound. These very low-frequency sound waves can travel long distances and easily penetrate most buildings and vehicles. Although disputed, some studies indicate transmission of long-wavelength sound may create biophysical effects including anxiety, uneasiness, and pressure on the chest.[24] When dealing with audible sound, you can cover your ears as a countermeasure, but there is no similar protection from infrasound. These effects have not been sufficiently substantiated or yet developed as a less-lethal device.

There are a number of existing and developing systems focused on communications and hail/warning (in both air and water). These generally fall into the category of acoustic hailing devices (AHDs). Some devices are optimized for verbal instructions and others for warning tones. One device might project a fairly directional lobe. Another device might project a higher sound pressure level (SPL) at range. The latest generations of these AHDs provide a fairly well-controlled acoustic lobe, which delivers improved levels of audibility, clarity and intelligibility. While the directivity of many of these devices is impressive, it does not mean that only targeted subjects can actually hear a given transmission (see acoustic profile below).



Typical AHD acoustic profile

These devices come in a variety of sizes and weights making them more or less portable. They employ a variety of common and proprietary technologies to generate and project sounds and communications including standard speaker horns and planar magnetic transducers. Some systems have been ruggedized and weatherproofed to sustain significant punishment in an operational environment.

Following the impressive technological advancements in solid-state electronics, advanced acoustic systems are continuing to emerge. As they become more operational, many of these AHD systems will be included in the inventory of law enforcement and corrections.

ACOUSTIC HAILING DEVICES

SOURCES: Manufacturer literature images

Magnetic Audio Devices
Long Throw Planar
Magnetic Speaker
LT-PMS-24

PowerSonix
PS-AHD-150

American
Technology
LRAD 500x

Barriers and Entanglements

SOURCE: INLDT Photo

Historically, barriers have been used to control and manage the movement of people and vehicles by means of constructing or emplacing obstructions (man-made or natural). These systems are largely "passive" in that once emplaced, they require no action from law enforcement and are triggered by the actions of a subject or subject vehicle. Similarly, entanglements have been used to restrict or inhibit movement. However, these systems are largely "active" in that they normally require an officer to engage a specific subject or subject vehicle directly. As with other less-lethal devices, selecting the appropriate barrier or entanglement system (or combination of systems) for an operation, event, or situation requires careful consideration of tactical context, local use-of-force policy, and risk assessment.

Mechanical Barriers. Mechanical barriers have long been used for restricting the movement of both people and vehicles. These devices include bollards, barricades, and stanchions. In the last several decades, the need for portable systems has generated systems made of high strength materials that are inflatable or water-filled. Additionally, collapsible trailer mounted systems have reached the market. More complex varieties include large-area "arrestor" types that operate similar to the cable arresting systems on military aircraft carriers. [25]

SOURCES: Manufacturer literature images

Since the attacks on 9/11, pre-emplaced tire deflation or barrier systems have increased exponentially as a major component of building and site security. It is also useful to note that the speed of a vehicle at impact largely determines whether or not mechanical barriers are less-lethal or lethal.

Vehicle Entanglements. Although there have been a number entanglement systems developed over the years to apprehend suspects, most physical entanglement systems today focus on vehicles and watercraft. These systems generally leverage high strength mesh polyethylene fibers and proprietary launching systems to ensnare the wheels, axles, or drive shafts of vehicles. Some even surround or encapsulate the entire vehicle.[26] Portability varies between models. There are models that include road spikes imbedded in the webbing. As with mechanical barriers, the risk to the subject vehicle increases at higher speeds.

> Critical demonstrations of such devices will have to include their relative safety (avoiding vehicle roll-overs, tips for operator safety, etc) and the strength of their attachment to the ground.[27]

Maritime Entanglements. Less-lethal systems for stopping boats are primarily net-like entanglement systems. Most systems in use today consist of pre-emplaced barriers or systems deployed immediately in front of a fleeing boat. Like vehicle entanglements, modern maritime nets are lightweight and made of super-high-strength synthetics. They stop vessels by entangling the propellers or obstructing engine intakes

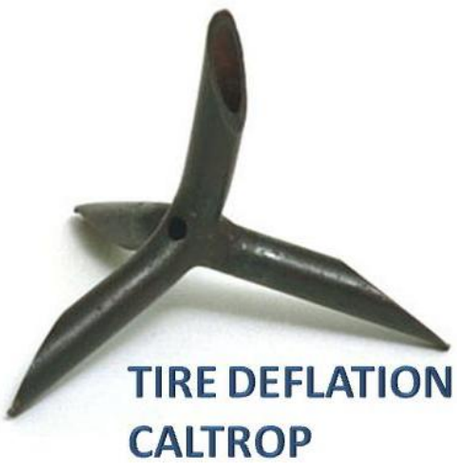
of non-compliant vessels. Placement of the netting is an important issue. These nets are normally pre-emplaced or shoulder fired ahead of a targeted boat. Alternatively, some models can be launched from fixed platforms on surface vessels.

SOURCE: Images provided by the USCG

Virtual Entanglements. There are electronic technologies that are useful from a criminal justice perspective in that they can inhibit the function of vehicle systems. The first is cooperative technology (for example, the OnStar® "Stolen Vehicle Slowdown" and "Remote Ignition Block" services). Equipped vehicles can be sent a cellular signal immobilizing the subject vehicle transmission, causing the vehicle to lose power and eventually come to a controlled stop. These vehicle ignition systems can also be disabled with a cellular signal once the vehicle is identified as stolen. The advent of "smart" roads and buildings that can communicate with vehicle systems holds great potential for cooperative technologies.

Tire Deflation Devices (TDDs). These are a family of systems designed to prevent, impede, or stop the movement of a motor vehicle by means of causing the tires of that vehicle to deflate.

Caltrops. Caltrops represent one of the simplest barrier options. Caltrops were frequently used to harass enemy vehicle traffic during operations by Office of Strategic Services (OSS) agents in the European theater during World War II. Modern caltrops are designed with four projecting spikes arranged in such a way that, when on the ground, the caltrops sit on three spikes and one spike is always straight up.



Caltrops with hollow spikes will flatten even tires that have been designed to close up around a puncture.[28]

Spike Strips and "Stop Sticks." Spike strips of various types have been developed over the last several decades to assist law enforcement agencies in stopping automobiles. In the 1970s, steel spikes designed to puncture tires were welded to platforms which permit the placement of the spikes across roadways or driveways.

These were designed to prevent terrorists, primarily in Europe, from approaching security and military facilities in vehicles. Originally, these platforms were either rigid one piece devices approximately 10 feet wide. Later, they were designed so that they could be "folded" and carried in a military or police patrol unit. The spike strip could be removed from the trunk. Once telescoped out to its full length, the spike strip could then be placed across a roadway. These types of spike strips are useful to a stationary checkpoint and/or roadblock. Spike strips are already available to civilian law enforcement.

> The most successful tire deflation systems in current use are "spiked strips" that consist of sharpened, hollow steel spikes that are press-fitted into expandable strips of various lengths. When a pursued vehicle runs over a strip, the spikes are embedded in the tires and pull loose from the strip, remaining in the tires and allowing air to escape at a controlled rate. This prevents blowouts and allows safe steering to continue until the tires are flat and the vehicle slows to a manageable speed. [29]

SOURCES: Manufacturer literature images

There are drawbacks to spike strips. A driver operating a vehicle with tires deflated by a spike strip can continue driving on the rims. In a vehicle pursuit, a vehicle containing the spike strips must be in front of the fleeing vehicle. It is not uncommon for civilian vehicles and/or police cruisers to hit these devices before they can be removed from the roadway.

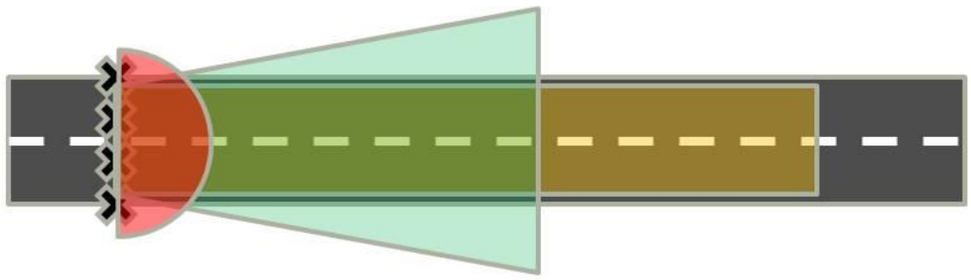
STOP STICKS® are essentially the same, however the Teflon coated, hollow "quills" are press-fitted onto a Styrofoam tube inside lightweight plastic sections. Each section fits into a series of linked canvas bags. These linked sections can be easily thrown onto the roadway and retrieved with a lanyard. Because of their caltrop like design, each section lands on the roadway with rows of "quills" standing up.

SOURCE: Manufacturer literature image

In 2010, NIJ's Weapons and Protective Systems Technologies Center characterized the behavior of three Tire Deflation Devices (TDDs). Three of the most popular devices in use at that time were selected (Stop Stick, Magnum Spike, and Federal Stinger) based on a survey of law enforcement professionals. Attributes that yield some indication of performance with respect to safety concerns (and devoid of any quail-tative judgment of 'good' or 'bad') were selected:

- Typical deflation time
- Typical number and location of deflated tires
- Direction and magnitude of device/handle movement
- Direction and magnitude of spike 'throw' and movement

The safety metrics used aimed to aid law enforcement policymakers and officers in determining suitable levels of 'buffer' space downstream when deploying TDDs, and also perhaps an amount of slack that should be present with each device's retention cord.[30]



Tire Deflation Devices:
Stop Stick, Stinger, Magnum Spike

Spike Scatter Zone
The area where spikes are likely to scatter after vehicle tires strike the TDD.

Immediate Danger Area:
The area around the TDD that poses potential risk to officers and bystanders.

Spike Release Zone
The area of roadway where there is a risk of encountering spikes that have fallen out of a suspect's tires after striking a TDD.

Tire Deflation Device (TDD) Attributes

Device / Metric	StopStick	Stinger	Magnum Spike
Deflation time at 35 mph	35 sec	17 sec	11 sec
at 55 mph	28 sec	22 sec	11 sec
at 75 mph	30 sec	18 sec	17 sec
Immediate Danger Area	**52 ft**	**14 ft**	**6 ft**
Spike Scatter Zone	**N/A**	**N/A**	**100 ft wide 120 ft downrange**
Spike Release Zone	**N/A**	**N/A**	**1/8 mile**
Percent time only 1 tire hit	17%	17%	17%
only 2 tires hit	33%	83%	83%
only 3 tires hit	33%	0%	0%
all 4 tires hit	17%	0%	0%

SOURCE: WPSTC – Characterization Study funded by NIJ in 2010. These characteristics do not necessarily represent criteria important for successful deployment or effectiveness against any particular vehicle.

Chapter 4 Endnotes:

[1] Non-Lethal Weapons: Policies Practices and Technologies Certificate Program, Kinetics Module, Penn State University (Fayette Campus), Uniontown, PA. 2009.

[2] Ibid. kinetics module.

[3] Ibid.

[4] John M. Kenny, Sid Heal, and Mike Grossman, *The Attribute-Based Evaluation of Less Than Lethal, Extended Range, Impact Munitions,* State College, PA: Penn State University Applied Research Laboratory, 2001, p.11.

[5] Non-Lethal Weapons: Policies Practices and Technologies Certificate Program, Kinetics Module, Penn State University (Fayette Campus), Uniontown, PA. 2009.

[6] Ibid.

[7] John M. Kenny, Sid Heal, and Mike Grossman, *The Attribute-Based Evaluation of Less Than Lethal, Extended Range, Impact Munitions* (State College, PA: Penn State University Applied Research Laboratory, 2001), p.9.

[8] Ibid. p.10.

[9] Ibid. p.10.

[10] Non-Lethal Weapons: Policies Practices and Technologies Certificate Program, Kinetics Module, Penn State University (Fayette Campus), Uniontown, PA. 2009.

[11] Article II (Definitions and Criteria), The Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on Their Destruction (1993 CWC), opened for signature Jan. 13, 1993, Organization for the Prohibition of Chemical Weapons, 32 I. L.M. 800 (1993), paragraph 2.

[12] Art II, 1993 CWC, paragraph 9(d).

[13] Kalman, Matthew. New York Daily News.com, "Israel cops try common scents crowd control," 7 Sept 2008.

[14] Inter-Service Non-Lethal Individual Weapons Instructor Course Manual (Fort Leonard Wood, MO: U.S. Marine Corps, 2004), pp.9-4.

[15] Eugene J. Olajos and Woodhall Stopford, Riot Control Agents: Issues in Toxicology, Safety, and Health (New York, NY: CRC Press, 2004), Chap. 1-12.

[16] Product must be in excess of ninety-nine percent purity with no binders, fillers, dyes or unknown substances.

[17] Inter-Service Non-Lethal Individual Weapons Instructor Course Manual (Fort Leonard Wood, MO: U.S. Marine Corps, 2004), pp.9-12.

[18] Non-Lethal Weapons: Policies Practices and Technologies Certificate Program, RCA Module, Penn State University (Fayette Campus), Uniontown, PA. 2009.

[19] Ibid.

[20] Defense Technology and Federal Laboratories, Oleoresin Capsicum Resin Basic Instructor Certification Program Manual, Jacksonville, FL, 2002, pp.14-15.

[21] Committee for an Assessment of Non-Lethal Weapons Science and Technology, National Research Council, (2003), *An Assessment of Non-Lethal Weapons Science and Technology,* Washington, DC: The National Academics Press, p.29.

[22] Doug Beason, Ph.D., "The E-Bomb: How America's New Directed Energy Weapons Will Change The Way Future Wars Will Be Fought," Da Capo Press, Perseus Books Group, Cambridge, MA, 2005, p.114.

[23] Non-Lethal Weapons: Policies Practices and Technologies Certificate Program, Advanced and Emerging Technologies Module, Penn State University (Fayette Campus), Uniontown, PA. 2009.

[24] *Infrasonic* concert, Purcell Room, London, 31 May, 2003, sponsored by the *sciart Consortium* with additional support by the National Physical Laboratory (NPL).

[25] Ibid. Maritime Vessel and Land Vehicle Stopper Module.

[26] Ibid.

[27] Osborne, Robert, Pursuit Management Task Force Report, US Dept of Justice, Office of Justice Programs, National Institute of Justice, El Segundo, CA: The Aerospace Corporation, September 1998, p.37.

[28] Ibid.

[29] Ibid, p.36.

[30] This study was funded by NIJ and is only a separate characterization of each TDD. No comparisons of TDD against criteria for successful deployment or assessment of effectiveness against any vehicle were made.

5 PLANNING FOR, ACQUIRING, & MANAGING TECHNOLOGY

Lessons Learned – Real Case Scenarios

During the late evening hours of June 4th, 1995, two Los Angeles Sheriff's Department deputies were assigned to handle a family disturbance in a residential neighborhood in Norwalk, a contract city in the southeastern portion of the county. Immediately upon their arrival deputies saw the suspect menacingly waving a large machete in the backyard of the location. After numerous futile attempts to get the suspect to drop the weapon, the situation became deadly as the suspect rushed toward the deputies. One of the deputies was armed with a shotgun with newly issued "stunbag" munitions and fired directly at the suspect, bringing him to the ground. Before he could be handcuffed the suspect regained his footing and attacked. The deputy fired three more times before the suspect was subdued. After handcuffing, the suspect was examined for injuries. There was deep bruising in his torso area where three of the projectiles had hit. The fourth had broken open and a number of the small lead pellets had entered the left arm, eventually requiring surgery.

This incident was noteworthy in that it marked a sea change in the way that incidents of this type were handled in the county. First and most important, lethal force would certainly have been used had the suspect charged the same deputies just 60 minutes earlier. The deputy who fired the less-lethal projectiles only had them issued 35 minutes prior to the incident. Second, as bad as the injuries to the suspect appeared, the outcome was preferable to the lethal alternative. Finally, it was clear that the manner in which a less-lethal weapon was employed was as important as the characteristics of the munition itself.

Since that time, the law enforcement community has had tens of thousands of similar experiences, and these original lessons have been validated and reinforced. Over time, less-lethal weapons and munitions have become both safer and more effective. Policies, procedures, tactics, and training have been developed to avoid or mitigate serious injuries by prescribing how they should be employed. Situations that historically have necessitated lethal force are increasingly being resolved without deaths. Perhaps the most important lessons learned are that future less-lethal options must be examined in the light of the experiences from which their need emerged and that insights from operational deployments must be adapted to new technologies, capabilities, policies, tactics, procedures, and techniques.

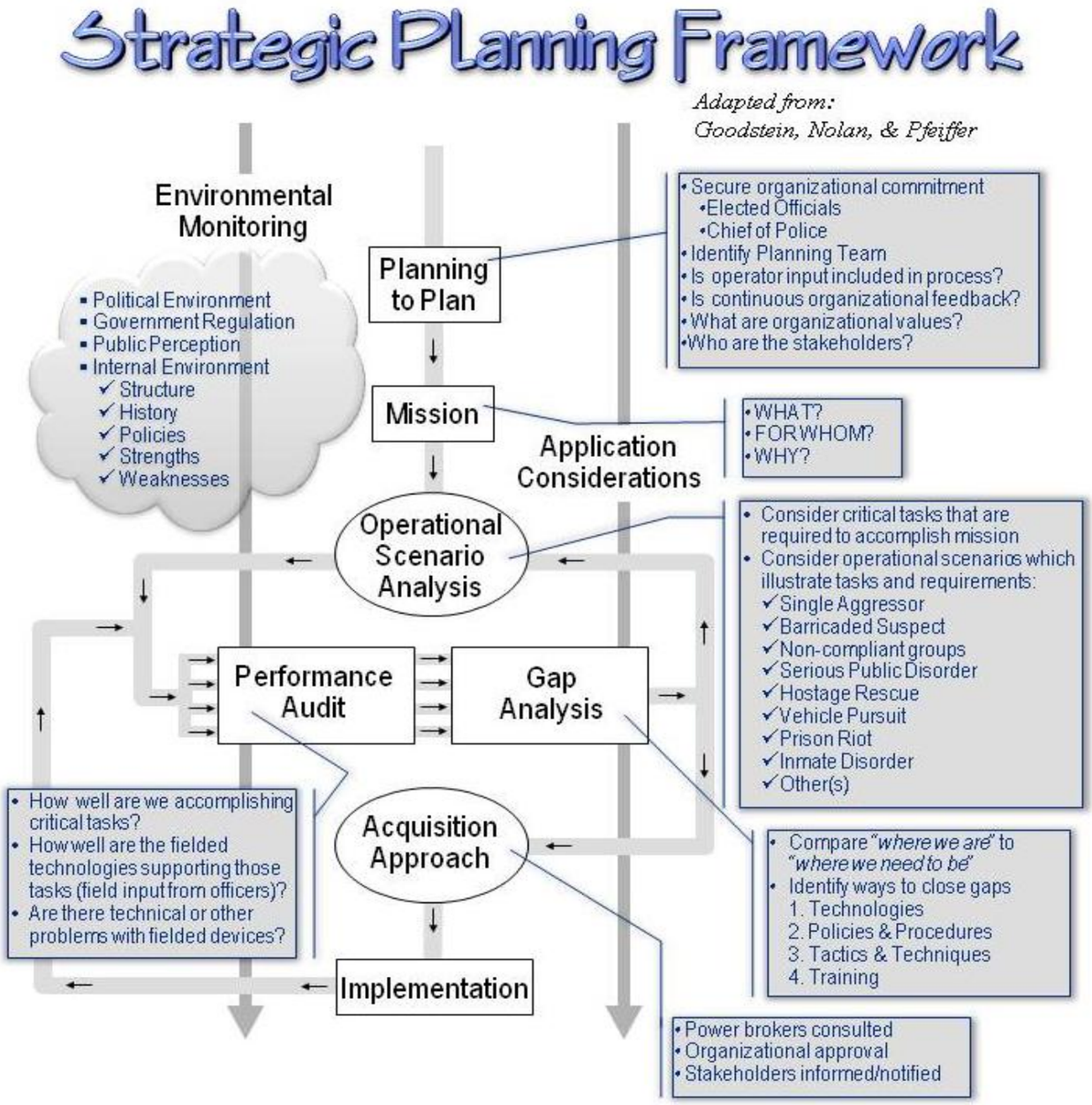
Department Strategic Planning – Having a Technology Vision

It would be difficult to understate the importance of a well-crafted strategic plan for the selection, acquisition, and use of less-lethal devices. Such a plan not only provides the general guidance necessary but establishes priorities, allocates resources, and assigns responsibilities. This is of particular importance with regard to less-lethal devices because there are no universally accepted standards, no commonly accepted taxonomy, no standardized training requirements, and no reliable methods for comparison. Consequently, each agency is left to develop its own protocols and policies. It would seem prudent, then, to establish some criteria for those devices which promise to fulfill the particular requirements for a given agency and avoid those that may seem promising but be expensive, awkward, publicly unacceptable, or otherwise inappropriate.

A strategic plan is not a static document – it is a dynamic process that anticipates requirements and provides a means by which those requirements might be addressed. It is essential that this process be integrated into the overall strategic planning process for the entire agency. While there are numerous frameworks available most have common features. This section will focus on those features that are critical in the acquisition of technologies in general and less-lethal devices specifically.

Most simply, strategic planning is a thought process that includes three major considerations: ***the Ends*** (the departmental goals that support the mission), ***the Ways*** (the methods that the organization uses to achieve those ends), and ***the Means*** (the resources used to accomplish the ways). There are a number of strategic planning frameworks that can be integrated into departmental processes as a means to "think through" the ends, ways and means in a more rigorous fashion.

Strategic planning usually begins with a common understanding of the current situation and why change is necessary. This historical background provides a context from which to understand what is involved. It also facilitates the identification of possible obstacles and potential opportunities.



Example of a strategic planning process framework (adapted from Goodstein, Nolan, & Pfeiffer)[1]

Strategic planning is intended to achieve a clearly identified objective – in this case, providing the necessary less-lethal devices to accomplish tasks that support the departmental mission. This part of planning provides the necessary focus and ensures that the efforts of all involved are complementary, not competing or counterproductive. Considering different operational scenarios that illustrate and support required tasks and their relative frequency is one method of identifying potential technology requirements.

The process should yield a better understanding of the capability gaps that exist in the department that might be addressed by technologies. Ultimately, the focus is to then determine the best approach for acquiring the appropriate technology (see *Acquisition Process* section).

The strategic planning process should also consider the strengths and weaknesses of the department or agency as well as any external opportunities and threats that might impact on efforts to achieve the objective.

Most strategic planning involves a review process and feedback loops. Situations change and assumptions often prove invalid. A review process ensures that the plan is continually "tuned" to adapt to changes in the environment and overcome obstacles. A dynamic strategic planning process enables the exploitation of opportunities and avoids or mitigates emerging threats. Such planning often proves an advantage when opportunities for acquiring new technologies and/or obtaining funding unexpectedly present themselves. The process also ensures both proper consideration of "stakeholder" input (e.g., from the officers in the field and the community) and necessary support of "powerbrokers" (e.g., key staff, Chief, elected officials, the community).

Stakeholder Buy-in: Officers, City, Agency, and Community

Even when necessary and reasonable, force has always been controversial. Moreover, regardless of the sophistication or capabilities of new options, there is no expectation that use-of-force will not remain necessary in the future. Likewise, there will continue to be unexpected outcomes which result in criticism – perhaps from those with agendas who are quick to bring failures to the limelight. In this regard, "buy-in" of stakeholders and powerbrokers is a critical component of any less-lethal weapons program.

While it is impossible to identify everyone who might have a stake in the successful employment of less-lethal options you can be sure that the community, the agency, and the user are three of the most important. In that the ultimate arbiter of acceptable force options is the community-at-large, great care should be taken to ensure they fully understand the implications of a particular force option. A knowledgeable populace is far less likely to jump to conclusions or mischaracterize a situation that turns out badly. Every opportunity to properly inform the public should be exploited. Historically, this has proven to be even more critical before a new force option is first employed because the public is far more likely to consider the totality of the circumstances than fixate on a highly emotional event or be led astray by fringe special interests groups.

SOURCE: Kentucky State Police

SOURCE: AP Photo | Erik S. Lesser

Every opportunity should be exploited to properly inform the public on less-lethal devices and their use

The agency that selects and employs a new less-lethal option also has a critical interest in all aspects of the project. This includes considering the liability for adverse outcomes. Excessive costs may force decisions regarding the level of deployment (who gets them and who does not). Similarly, inexpensive devices may still require extensive training, maintenance, or calibration – hidden costs that must be absorbed. Some devices are fragile, have particular storage requirements, or require unique cartridges or batteries and so are likewise unappealing.

The user is often the least considered stakeholder, but without a doubt the most important. A device that is awkward to carry or employ may not be available when needed. A device that requires special care will require precautions and consideration that divides attention better focused on other things. Because less-lethal options are not yet very versatile, especially regarding engagement ranges, the user is often required to make quick decisions whether a particular device is the most appropriate for a given situation.

Worthy of mention as a stakeholder are activist groups which often have a particular aversion to one type of device or another. As stakeholders, they tend to be ignored or overlooked and can quickly become a threat to the selection or continued use of a given device. In many cases, their intentions are noble but their information is wrong. While it is certainly not possible to expect that activists (especially those of the militant variety) will be persuaded in all cases, attempts should be made to provide them with correct and complete information when a particular device or use of force is challenged. A failure to adequately respond can appear deceptive or concealing to the public and so have the opposite of the intended effect.

Acquisition Process

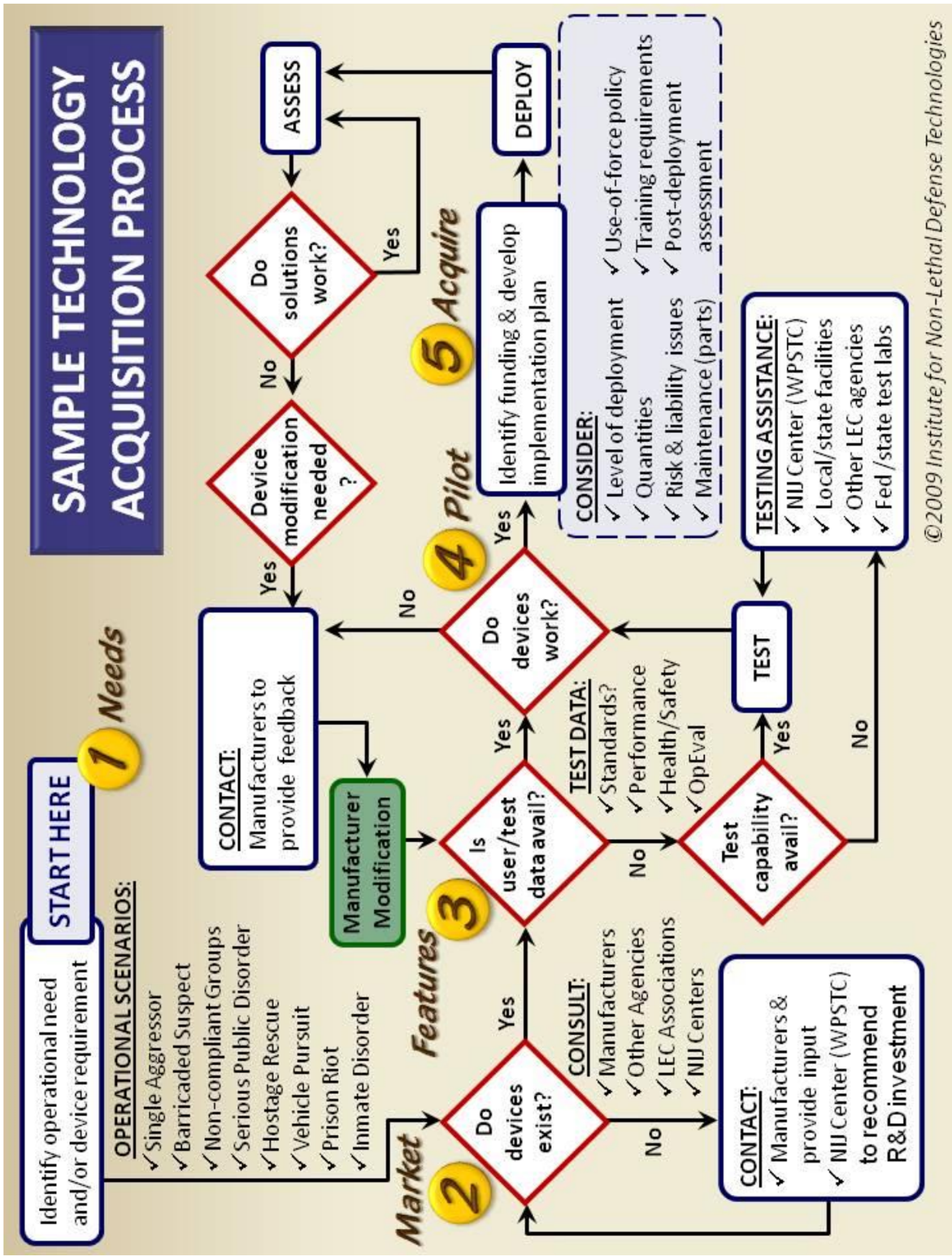
While federal government agencies follow a fairly formal acquisition process, most state and local U.S. law enforcement agencies do not have the resources or capacity to expend in this regard. Nonetheless, understanding the steps of a formal process and the reasoning behind those steps can serve smaller departments in their efforts to acquire commercially available and developing less-lethal technologies. The flow chart entitled "Sample Technology Acquisition Process" is provided to graphically depict such a process. As an overview, the following steps provide a general outline of how such a system works.

The **first step** in acquiring less-lethal devices is to identify the **need**. Some devices built and intended for one application may be completely inadequate or inappropriate for another. For example, a less-lethal option suitable for controlling a single assailant may be inadequate for handling a riot. Likewise, one that is intended for resolving a major disorder may be overkill for handling a family disturbance. Factors like portability, decontamination, duration of effects, and range must all be considered in articulating the need.

The **second step** is to determine whether a particular device is **available**. As less-lethal options are becoming more prevalent this step is becoming easier, both due to commercial availability and adaptability of devices. In some cases, however, this step will require consulting with manufacturers, scientists, professional associations, and other law enforcement agencies to identify the requirements and develop a suitable device. The National Institute of Justice Centers of Excellence are another important resource that can provide insight.

When a device is available, the **next step** is to determine the required performance characteristics and other important capabilities as well as how they are related to the need. Most of the **features** are easily obtained either from the manufacturer or by simple measurement. The size and weight of a device, its durability, precision, and accuracy are all important aspects as to how it will eventually be deployed. By far, however, the most important factors involve effectiveness. Historically, this has been problematic since human testing is not only extremely expensive but can take years. Furthermore, it is never exhausttive and is impossible to completely predict how a particular force option affects people across broad demographics (extremely large or small, old or young, emotionally disturbed, under the influence of drugs/alcohol or vulnerable portion of the population). Criminal Justice

practitioners encounter situations daily that require a force intervention. Lacking effective less-lethal options, they are often compelled to use harsher alternatives. Recognizing that there are no "perfect solutions," the law enforcement community has often embraced any option that offers a safer alternative than deadly force.



The **fourth step** usually takes the form of a **pilot** project. A pilot project is a small preliminary study in which a device is field-tested for feasibility and requires close scrutiny and detailed reporting. Arguably, this is the most crucial step before implementation. Pilot projects for force

options are particularly important because of the unique demands involved in actual confrontations. Unlike laboratory testing or research experiments (which seek to control for a variety of variables in order to objectively quantify performance measures), pilot projects seek to immerse the technology in the operational setting where suspects or inmates are actively attempting to avoid or overcome the device and take evasive and defensive actions. Moreover, suspects and inmates are frequently enraged, emotionally distraught, under the influence of drugs, and in difficult environmental settings that do not optimize the technical performance of these technologies.

The **last step** is focused on purchasing, distributing, and employing the new technology – the actual **acquisition**. This is usually done at the executive level. Typical issues involve who should be authorized to use a particular device, what training is required, how it should be carried and stored, under what conditions it should be used, and what procedures are necessary to manage risk. Procedures for capturing and storing evidence also need to be part of the plan. Of particular importance is where a force option fits with existing force options. It is essential to address these issues before an incident makes a device controversial. Other considerations include:

- ***Conditions.*** What issues have to be addressed with regard to equipment compatibility, scheduling, capability or performance constraints?
- ***Risks.*** What technical, cost, and liability risks are associated with the deployment of the technology? Is there a public information and awareness component?
- ***Logistics.*** Have you considered how maintenance and servicing will be performed? What about product reliability, maintainability, quality assurance, warranties and data rights?
- ***Costs.*** What are the hidden costs? Have you considered the total life-cycle costs including replacement supplies, maintenance, repairs, parts, and associated warrantees?
- ***Other considerations***. What about source-selection procedures? What criteria will you use to select the vendor? Are there any environmental concerns or energy conservation issues? What about department and regional standardization issues?

Chapter 5 Endnotes:

[1] Goodstein, L.D., Nolan, T.M., Pfeiffer, J.W., Applied Strategic Planning: How to develop a plan that really works, McGraw Hill, 1993.

6 CHALLENGES TO IMPLEMENTATION

Training Requirements

There are no mandatory training programs that reach across the broad spectrum of law enforcement services in the United States. Neither are there standards or universally accepted minimum requirements for training on less-lethal options. The impetus for meaningful training with less-lethal devices has been a combination of common sense and civil liability, not always in equal parts. Training programs that do exist are often provided by manufacturers or vendors but are nearly always focused on a particular style or brand. Some training programs focused specifically on law enforcement issues have been available since the late 1990s from organizations like the National Tactical Officers Association (NTOA) and the International Association of Chiefs of Police (IACP). As the field has matured, other programs are becoming available and are being certified by the authorizing agencies in the various states. Law enforcement agencies may use any one or any combination of training programs and quite often do. The importance of establishing clear and definitive guidelines and policies should be self-evident.

Many instances where police are called upon to deal with aggressive and resisting individuals are stressful and change rapidly. **Tactical Decision Making** training is intended to reduce the frequency for a bad outcome during these tense encounters. The force-on-force training methodology is ideal to simulate stressful environments and to assess the appropriateness of the police response. These decision-making exercises are designed to illustrate the advantages of tactical principles in the application of force during conflicts. Some of the basic tactical principles that should be considered include:

Space and Time. Within reason, more space between the officer and the offender provides more time to formulate a response and/or react. The space/time continuum is dependent on the weapons available to the suspect and the officer, as well as contextual and environmental considerations. Extended range launched impact projectiles provide the officer an ability to apply force to the suspect, when appropriate, while extending the distance between them. This minimizes the risks associated with close quarters contact with the suspect and allows for transition to other force options as necessary (including lethal force).

Forced Jeopardy. Whenever possible, officers should not to give up positions of tactical advantage to approach a suspect. Surrendering positions of tactical advantage can create unnecessary and dangerous conditions for both the officer and the suspect. Generally police officers seek to do the right thing – a noble cause. But becoming over anxious in order to apply force on a suspect can place the officer and assisting officers at risk unnecessarily. Officers must practice discipline to avoid confrontation whenever possible. Officers who unreasonably force a lethal encounter can be held liable under common law negligence principles for putting themselves in that situation.[1]

Contact Teams. When possible, officers should approach a crisis situation in a configuration such as a diamond formation. This can be accomplished with as few as two officers. The contact team allows for 360 degree coverage, better communication, and reduced cross-fire situations. This formation can also be integrated for active shooter, down subject rescue and any situation involving a high risk approach.

Multiple Options. There is no single best less-lethal tactic or weapon that can be applied to every situation. Officers should have multiple less-lethal tools available for different situations. They should also have as broad a spectrum of devices as possible to match the vast variety of problems they face every day.

Cover and Concealment. Cover is designed to protect the officer from lethal attack. Concealment is something that obscures the officer from view, but does not provide ballistic protection. Both of these concepts are still critical even when the officer is utilizing less-lethal weapons or tactics.

Contingency Planning. Officers should rehearse “what if” plans during a critical incident. Dealing with people in crisis can be tense and unpredictable. Planning ahead will allow for officers to better react to changing environments in crisis situations.

Static Control versus Crisis Response. Often during a critical incident the initial response by police can be negatively affected by miscommunication and uncertainty. Officers and commanders are reacting to quickly evolving events, which dictate the tempo of the operation. One of the roles of the commander or supervisor is to implement a plan to slow the operation down and move away from a crisis response to a more controlled environment. Reducing the potential for officer in-

duced jeopardy while containing the event at the beginning is crucial for managing crisis situations.

Once the situation is more or less static, developing less-lethal options and implementing coordinated planning during a critical event will often lead to a more successful resolution; assuming the initial crisis has been managed and variables have been mitigated. Having good containment and effective communication for example, enables the less-lethal operator to more effectively coordinate a less-lethal deployment plan. Utilizing less-lethal tools and tactics during a crisis is possible, but, in general the effort is to manage the event so that the less-lethal options can be deployed after command and control is in place.

Legal & Policy Issues

The use of any force is always accompanied by legal issues in both military and law enforcement operational settings. Questions and controversies continue to arise regarding everything from how well they worked to whether they should have been used in the first place. Some devices, such as calmatives and directed energy, are controversial even though there are no commercially available products and they have never been used in either the American law enforcement or military communities.

New and emerging less-lethal options are often contentious because they provide options that have never before been considered and challenge the habitual way of handing force situations. Realistically, when force is applied (or even threatened) someone is always offended. This strife manifests itself in everything from angry words to law suits.

As the less-lethal field continues to mature, courts have begun setting guidelines on what is acceptable and how a particular option should be used. One of the most important concepts is that regardless of the number or type of less-lethal options available, an officer will be judged on whether the force used was reasonable. This means that an officer is not required to use the least amount of force but only force that was objectively reasonable under the circumstances. The value of such things as training, experience, policy, and procedures then takes on greater importance. Accordingly, some states have prohibited citizens from owning, possessing, or using some less-lethal options that are standard police issue.

Court challenges of less-lethal options almost always allege excessive force. Excessive force is that which is deemed to be more severe than is necessary in either kind or duration. Excessive force by kind is that which inflicts more pain, suffering or injury than is deemed proper to accomplish the tactical objective. This almost always entails choosing the wrong weapon or munition or employing it outside established guidelines. Excessive force by duration is when force is applied longer than is reasonable.

Uses of some less-lethal technologies have been challenged in the US judicial system. The tactics, procedures, policies, training, and use are more often the issue rather than the technology itself. The body of law concerning legal liability issues for use of less-lethal weapons generally involves liability claims brought by plaintiffs under Section 1983 of the Civil Rights Act of 1871 (42 U.S.C.S. §1983). These suspects and prisoners most often claim excessive use of force based on injuries sustained from batons, impact projectiles, electrical devices, or pepper spray. Likewise, case law, such as the landmark Graham vs. Connor (490 U.S. 386, 1989) provides further guidance.

Of great importance is that the law assumes that persons are responsible for the logical and reasonable consequences of their actions. An officer needs to be able to fully comprehend and clearly articulate the reasons for his or her actions. A decision by a judge or jury will ultimately weigh an officer's training, experience, knowledge, skills, and abilities in deciding whether a particular force option was appropriately selected and applied. Nevertheless, given the nature of force in general, the use of many less-lethal devices will remain controversial for the foreseeable future.

Public Acceptability

Less-lethal alternatives for criminal justice practitioners have been evolving for nearly two decades. Driven by a concern for human rights and the desire to reduce risk of injury to both subjects and officers, the law enforcement and corrections communities have enthusiastically embraced less-lethal options. The application of these minimal force options allows police and corrections officers a means to establish control of situations and achieve positive outcomes for all involved. Because less-lethal options require substantially less provocation than lethal alternatives, an officer can employ minimal force options earlier in an escalating confrontation without accepting undue risk. This

allows officers to gain and maintain the initiative while reducing their own vulnerability and that of an assailant. Developing "positive outcomes" is an approach based on the ideals of proportionality and necessity. Despite best efforts, however, the possibility of unintended consequences cannot be eliminated absolutely – nor can unfavorable outcomes be avoided completely.

Regardless of the most noble intentions and gallant efforts to minimize injuries and save lives, the use of less-lethal options is not acceptable to everyone. Criticism has come from suspects, politicians, activists, and citizens. Arguments include the legitimate concerns for human rights and the potential for abuse as well as less cogent conspiracy theories as extreme as global population dominance and mind control.

SOURCE: INLDT Photo

A well-informed public can reduce the influence of extreme views regarding new technologies.

Critics claim that less-lethal weapons facilitate earlier engagement and could lead to unnecessary use or abuse. Unfortunately, these arguments are sometimes valid and in the American system of justice it is the exception that makes the rule when courts determine that the use of a less-lethal device was ill-advised, negligently applied, or used with **deliberate indifference**. Others argue that some less-lethal weapons will damage the environment, are unethical and inhumane, or violate international treaties and conventions. Some extremists even claim that less-lethal weapons development is part of a military-industrial

conspiracy to preserve its influence in the post-Cold War world. Conversely, some less-lethal weapons work so well that critics claim their continued development will make them available to criminals and terrorists who will use them for their own purposes or even by governments in suppressing legitimate dissent or as implements of torture.

Proponents of less-lethal options on the other hand, argue that these weapons provide a vital capability in an increasingly complex operating environment. They assert that sound policies and procedures for use, robust review mechanisms, and independent oversight bodies are the instruments for addressing inappropriate use of these systems. Furthermore, eliminating or greatly curtailing the use of less-lethal options simply dooms the confrontation to be resolved by far harsher methods – often lethal force. This public debate is a healthy and necessary part of ensuring that these systems are developed, controlled, and deployed with adequate policies, guidelines, and accountability.

Technology Downfalls

There are no perfect solutions. This holds true for the growing variety of less-lethal options that are available. This guide would, therefore, be incomplete if it did not address some of the failures and pitfalls encountered as some of these systems developed over the years.

The sting-bags which have proven so popular since the mid-1990s, for example, had their first use as early as the 1970s. Tragically, a suspect died and the ensuing furor effectively eliminated any impetus to continue the program. Moreover, developers and entrepreneurs were discouraged from developing any other kind of less-lethal technology so the entire effort languished for nearly twenty-five years.

Likewise, conducted energy devices (CEDs) in the form of “electronic batons” were available as far back as the late 1970s, but when they were misused by officers seeking statements from suspects, they were quickly discarded.

Though developed at a cost of tens of millions of dollars, directed energy systems have not yet been employed (either by the military or law enforcement). Other promising technologies have seen only limited use (e.g., malodorants) or have not even been adequately developed

(e.g., calmatives). Although these emerging technologies are intended to reduce injuries and save lives, they appear to be languishing for fear of potentially adverse community response, rather than legitimate and necessary informed public scrutiny.

While there are many lessons to be learned from these failures, one of the most conspicuous is that any less-lethal option needs the support of the public. A fully informed and supportive public is the center of gravity for any successful less-lethal program. This requires that every effort is made to ensure they have correct and comprehensive information. Agencies, manufacturers, and developers need to avoid non-descriptive, emotion arousing nomenclature when describing technologies. Failures need to be quickly and openly addressed with remedies immediately implemented. Misuse, in any form, must not be tolerated.

Chapter 6 Endnotes:

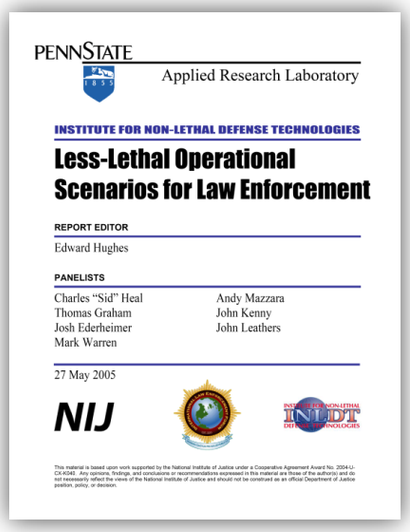
[1] UNITED STATES COURT OF APPEALS FOR THE TENTH CIRCUIT: LUCY QUEZADA, as personal representative of the estate of Berlinda Griego, deceased, Plaintiff-Appellee, v. THE COUNTY OF BERNALILLO; PATRICK SAUSER; ALVIN J. CAMPBELL, Defendants-Appellants No. 90-2014 944 F.2d 710 September 9, 1991.

ANNEX A

OPERATIONAL SCENARIO WORKSHEETS

General

The operational scenario worksheets contained in this annex were originally developed in 2005. A select panel of law enforcement and corrections expert practitioners were brought together by the Institute for Non-Lethal Defense Technologies (INLDT) at Penn State. The intent was to fully develop the scenarios in a form consistent with work conducted by the North Atlantic Treaty Organization (NATO), but focused on U.S. law enforcement operational needs, rather than the needs of the military.


PENNSTATE
Applied Research Laboratory

INSTITUTE FOR NON-LETHAL DEFENSE TECHNOLOGIES

Less-Lethal Operational Scenarios for Law Enforcement

REPORT EDITOR

Edward Hughes

PANELISTS

Charles "Sid" Heal
Thomas Graham
Josh Ederheimer
Mark Warren
Andy Mazzara
John Kenny
John Leathers

27 May 2005

NIJ

This material is based upon work supported by the National Institute of Justice under a Cooperative Agreement Award No. 2004-IJ-CX-K043. Any opinions, findings, and conclusions or recommendations expressed in this material are those of the author(s) and do not necessarily reflect the views of the National Institute of Justice and should not be construed as an official Department of Justice position, policy, or decision.

2005 Operational Scenario Report

The consensus view of the panel was that a finite set of operational scenarios could be the basis for a formalized thought process that would allow criminal justice practitioners to communicate needs to researchers, developers, and manufacturers. Each of the operational scenarios was then formatted into a worksheet containing the following elements:

- **Situation** – The title of the scenario (e.g., "Barricaded Suspect);
- **Description** – A short paragraph presenting some context for the situation.
- **Required Outcome** – A list of necessary mission "end-states;"
- **Environmental Factors** – Variables that contextually might impact on the technology, tactic, procedure, or technique considered; and
- **Applicable Responses** – Responses of subject(s) that would facilitate achieving the required outcome(s).

Methodology

For each of the draft operational scenarios, the panel discussed the "description" and came to agreement on the precise wording. It was also agreed that these "descriptions" should be brief and only specific enough to portray context. Too much detail might limit the possible approaches. Additionally, the group determined that "environmental factors" should account for the variability in the situation and drive the

technical, tactical, and/or procedural approach(es). It was also agreed that these operational scenario "descriptions" needed to be somewhat isolated. No branches or sequels were addressed. In other words, the panel consciously limited the scope of each individual scenario recognizing that during an encounter, an officer may find himself moving from one scenario to another. For example, after successfully and safely stopping a fleeing vehicle (Scenario 6), an officer may be confronted by a single aggressor (Scenario 1).

After reaching consensus on the scenario "description," the panel determined the corresponding necessary or "required outcomes." These were the desired "end-states" for the scenario or the tasks that would need to be accomplished in order for the situation to be considered successfully resolved.

After determining the "required outcomes" for the scenario, the panel proceeded to discuss and select applicable responses for the situation (those that would facilitate arriving at the required outcomes) from the seven "basis responses." For each of these "basis responses," the panel then arrived at a specific onset time, magnitude, target recovery state, and duration of effects.

Finally, for each of the scenarios, the panel considered environmental factors that would alter the context of the situation and possibly the technology, tactic, or procedure that might be used to achieve the required outcome. These environmental factors ranged from topography and weather to the presence of bystanders and noise.

A draft report was developed and staffed with the panelists and other U.S. law enforcement professionals. As a result, the corrections scenario was divided into two scenarios. It was also noted during the review that many of these scenarios rise to the level of lethal force if only one officer is present at the scene, which is often the case in smaller jurisdictions.

This may be viewed as either:

- Negating the scenario under that condition; or
- Demonstrating a need for technologies, tactics, or procedures that allow an officer to respond in a less-lethal fashion without further endangering his life.

The purpose of the scenarios is to describe the vast majority of operational needs and facilitate a thought process. The "single officer on scene" should be considered a possible variable to be addressed within the context of the scenarios.

Notwithstanding the diverse experiences of the panelists and some debate, the focused efforts of this select group of law enforcement practitioners resulted in a concise product. The eight scenario work-sheets capture useful operational input in a form consistent with the accepted NATO framework, but with a focus on U.S. law enforcement and corrections operational needs.

Findings were presented to the International Law Enforcement Forum (ILEF) at its 2005 workshop in Ottawa, Ontario (Canada). The scenarios have been in use since 2007 as a means to focus technology research and development efforts at the National Institute for Justice and as a basis for evaluating and assessing less-lethal devices. They can also be useful as a tool for law enforcement at the state and local level in conducting "what if" drills to identify potential gaps between existing tactical protocols, established policies and procedures, current individual techniques, and/or available technologies and those required/desired to address specific operational needs.

After some consideration, in 2010, the NIJ Technology Working Group for Less-Lethal Devices added of a scenario to illustrate less-lethal device requirements for *prisoner transport*. In 2011, the group revised the bottom portion of the worksheets in order to more readily illustrate operationally-based technology gaps. Those changes are included in this edition.

A blank worksheet is at the end of this appendix for use in capturing scenarios that might be unique or of particular interest to a jurisdiction. See Annex B (Glossary) for terms and definitions.

OPERATIONAL SCENARIO 1

SITUATION	**SINGLE AGGRESSOR – INCLUDING SUICIDE BY COP** **(RELATIVE FREQUENCY = 47%)**
DESCRIPTION	Patrol officers respond to a complaint of a disturbance in front of a residence. The man had been hitting his wife before police arrived and continues as several units arrive at the scene. He is holding a baseball bat in his hand. *Continued…*The man lets his wife free but will not drop the bat. Officer Smith had his weapon drawn. "Drop the bat! Drop it!" officers yelled. The man moves toward one of the police officers without dropping the bat.
DESIRED OUTCOME (PRIMARY OBJECTIVE)	► **Subject controlled & in custody** ► **Victim uninjured** ► **Subject minimal injury (temp)** ► **No officer injured/killed** ► **No bystanders injured/killed**
ENVIRONMENTAL VARIABLES	► **Topography & Vegetation – subject and officers barriers;** ► **Buildings & Structures (inside/ outside) –barriers subject and officers;** ► **Bystanders present (e.g., children, elderly, infirm)** ► **Visibility, lighting & time of day** ► **Weather (temperature, wind, precipitation, humidity)** ► **Subject(s) & Bystander(s)** ► **Mentally ill suspect** ► **Drug and/or alcohol induced subject** ► **Noise**

PRIMARY OBJECTIVE(S)	CURRENT OPTIONS	RELEVANT CAPABILITIES	LIMITATIONS	CAPABILITY GAPS
Subject controlled	**Impact munitions**	**Pain, Range Precision**	**Pain is Subjective**	**With the exception of CEDs when effective, other options do not control the suspect; rather, they cause pain.**
	CEDs	**Muscle tetany Pain (contact)**	**Range Targeting**	
	OC	**Pain Disorientation**	**Pain is subjective Agitation in some subjects Cross-contamination Decontamination**	
Subject in-custody	**Manual handcuffing**	**Generally metal handcuffs**	**Requires contact with suspect**	**Coordinate with control process**

OPERATIONAL SCENARIO 2

SITUATION	**BARRICADED SUSPECT (RELATIVE FREQUENCY = 11%)**
DESCRIPTION	Patrol officers respond to a disturbance call at the Happy Hotel. The officers are told that a lone, wild-eyed, disheveled, male entered the small office of the motel/hotel. He stated he has a handgun but none was observed. Fearing for their safety the employees and patrons fled. The suspect remains alone in the office area and can be seen throwing objects and breaking furniture and windows.
DESIRED OUTCOME (PRIMARY OBJECTIVE)	▶ **Subject controlled and in custody** ▶ **Subject minimal, if any, injury (temp)** ▶ **No officer injured/killed** ▶ **No bystanders injured/killed** ▶ **Minimal property damage**
ENVIRONMENTAL VARIABLES	▶ **Topography & Vegetation - barriers between subject and officers;** ▶ **Buildings & Structures (inside/outside) – barriers between subject and officers; ventilation systems** ▶ **Bystanders present (e.g., children, elderly, infirm)** ▶ **Visibility, lighting & time of day** ▶ **Noise** ▶ **Weather (temperature, wind, precipitation, humidity)** ▶ **Subject(s) & Bystander(s)** ▶ **Mentally ill suspect** ▶ **Drug and/or alcohol induced subject**

PRIMARY OBJECTIVE(S)	CURRENT OPTIONS	RELEVANT CAPABILITIES	LIMITATIONS	CAPABILITY GAPS
Subject controlled	**Impact munition**	**Pain Precision**	**Pain is subjective Line-of-sight system**	**Limitation of all pain compliance devices is that the suspect's intentional cooperation is still necessary. There are no control devices for uncooperative subjects other than CEDs.**
	OC	**Pain Disorientation**	**Agitation Cross contamination Decontamination**	
	CS	**Pain Disorientation**	**Cross contamination Decontamination**	
	Distract Device (balls)	**Disorientation**	**Very temporary effect**	
Subject in-custody	**Manual handcuffing**	**Generally metal handcuffs**	**Requires contact with suspect**	

OPERATIONAL SCENARIO 3

SITUATION	**NON-COMPLIANT GROUPS (RELATIVE FREQUENCY = 4%)**
DESCRIPTION	During a protest, about 250 protesters from a crowd of about 1,500 demonstrators have severely restricted the entrance of a convention center during a convention. While officers have been able to enforce adherence to all the issued permits to this point, a "sit-in" along this main thoroughfare exceeds the boundaries of the permit for public demonstration. It also causes serious concerns for the safety of the participants, including some foreign heads of state, and impedes the free access to local business and traffic thoroughfares. The protestors are refusing to leave. A number of city television stations have established reporting sites within the protest group and outside of the controlled area. There is legal necessity to clear the thoroughfare and remove those engaged in the "sit in" portion of the demonstration.
DESIRED OUTCOME (PRIMARY OBJECTIVE)	► **Subject group compliance** ► **Subjects minimal injury (temporary)** ► **No officer injured/killed** ► **Minimal disruption to the event** ► **Minimal impact on surrounding community and businesses** ► **Avoid mass arrests (or any arrests) if practical**
ENVIRONMENTAL VARIABLES	► **Topography & Vegetation – subject and officers barriers;** ► **Buildings & Structures (inside/outside) – barriers;** ► **Visibility, lighting & time of day** ► **Weather (temp, wind, precipitation, humidity)** ► **Noise** ► **Number of officers available** ► **Subject(s) & Bystander(s) – Size, density and proximity** ► **Emotional state and degree of commitment to cause of group** ► **Intelligence, including history of group** ► **Ability to transport and house arrestees**

PRIMARY OBJECTIVE(S)	CURRENT OPTIONS	RELEVANT CAPABILITIES	LIMITATIONS	CAPABILITY GAPS
Group compliance	**Impact munition**	**Pain Precision**	**Pain is subjective Line-of-sight system**	**Technology needs to provide incentive for persons to comply with lawful orders and disperse peaceably.**
	OC	**Pain Disorientation**	**Agitation Cross contamination Decontamination**	
	CS	**Pain Disorientation**	**Cross contamination Decontamination**	
	Distraction Device (balls)	**Disorientation**	**Very temporary effect**	
	Acoustic hail & warning devices	**Communication Annoyance Disruption**	**Warnings to highly motivated are ineffective**	**May dissuade only less serious**

OPERATIONAL SCENARIO 4

SITUATION	**SERIOUS PUBLIC DISORDER (RELATIVE FREQUENCY = 4%)**
DESCRIPTION	Reports that citizens of the city have taken to the streets after violence broke out during a protest. Numerous acts of rioting, arson, and looting are taking place. The city fire department officials report that many large stores are burning, and that numerous cars have also been set afire and are blocking intersections.
DESIRED OUTCOME (PRIMARY OBJECTIVE)	▶ **Mob dispersed** ▶ **Rioters controlled & in custody** ▶ **Area denial** ▶ **Rioters minimal injury (temporary & reversible effects)** ▶ **No officer injured/killed** ▶ **Minimal impact on surrounding community and businesses (property damage, looting, arson)** ▶ **No uninvolved persons injured or arrested**
ENVIRONMENTAL VARIABLES	▶ **Topography & Vegetation – barriers between subject and officers** ▶ **Buildings & Structures (inside/outside) – barriers between subject and officers** ▶ **Visibility, lighting & time of day** ▶ **Noise** ▶ **Effects from smoky conditions** ▶ **Weather (temperature, wind, precipitation, humidity)** ▶ **Subject(s) & Bystander(s) – Size, density and proximity** ▶ **Emotional state and degree of commitment to cause of the group** ▶ **Intelligence, including history of the group** ▶ **Number of officers available**

PRIMARY OBJECTIVE(S)	CURRENT OPTIONS	RELEVANT CAPABILITIES	LIMITATIONS	CAPABILITY GAPS
Mob disbursed	**OC**	**Pain Disorientation**	**Agitation Cross contamination Decontamination**	**Differentiated effects upon persons lawfully assembled and those engaging in criminal behavior. Need them to not re-emerge elsewhere.**
	CS	**Pain Disorientation**	**Cross contamination Decontamination**	
	Distraction Device	**Disorientation**	**Very temporary effect**	
	Acoustic hail & warning devices	**Communication Annoyance Disruption**	**Warnings to highly motivated are ineffective**	
Rioters controlled	**Impact munition**	**Pain Precision**	**Subjective**	**Need to identify, differentiate, and address lawbreakers**
	CEDs	**Pain Incapacitate**		
Rioters in-custody	**Manual handcuffing**	**Generally metal handcuffs**	**Requires contact with suspect**	

OPERATIONAL SCENARIO 5

SITUATION	**HOSTAGE RESCUE – CLEARING FACILITIES (RELATIVE FREQUENCY = <1%)**
DESCRIPTION	A group of around fifteen armed men and women have stormed Smith Middle School. Most of the attackers wore black ski masks. The attackers seized the school building and have taken more than 400 people hostage, nearly all of them students. A security perimeter has been established around the school, consisting of city police officers, county sheriff's department, the state police and SWAT teams.
DESIRED OUTCOME (PRIMARY OBJECTIVE)	► **Subject(s) controlled and in custody** ► **Subject minimal injury (temporary) – Note that more serious injury to subjects is tolerated if hostages are threatened with serious injury** ► **No hostages or bystanders killed or seriously injured** ► **No officer injured/killed** ► **Limited property damage**
ENVIRONMENTAL VARIABLES	► **Topography & Vegetation – barriers between subject and officers;** ► **Buildings & Structures (inside/ outside) – barriers between subject and officers;** ► **Visibility, lighting, time of day,** ► **Weather (temperature, wind, precipitation, humidity)** ► **Noise** ► **Number of Subjects (hostage takers)** ► **Number and physical condition of hostages (very young, ill, etc.)** ► **Bystander(s)** ► **Operational Intelligence** ► **IEDs, and other secondary threats**

PRIMARY OBJECTIVE(S)	CURRENT OPTIONS	RELEVANT CAPABILITIES	LIMITATIONS	CAPABILITY GAPS
Subject controlled	**Impact munition**	**Pain Precision**	**Pain is subjective Line-of-sight system**	**Need near-instantaneous onset of effects upon suspects. Effects must be reversible so as to not seriously injure hostages or others.**
	OC	**Pain Disorientation**	**Agitation Cross contamination Decontamination**	
	CS	**Pain Disorientation**	**Cross contamination Decontamination**	
	Distraction Device (balls)	**Disorientation**	**Very temporary effect**	
Subject in-custody	**Manual handcuffing**	**Generally metal handcuffs**	**Requires contact with suspect**	

OPERATIONAL SCENARIO 6

SITUATION	**VEHICLE PURSUIT – SAFELY STOPPING FLEEING VEHICLE** **(RELATIVE FREQUENCY = 18%)**	
DESCRIPTION	After activating his red lights and siren to stop a car, the suspect driver speeds away. In accordance with law and department policy, the situation demands that the vehicle be stopped.	
DESIRED OUTCOME (PRIMARY OBJECTIVE)	► **Target vehicle safely stopped** ► **Target vehicle occupants minimal or no injury (temporary)** ► **No officer injured/killed**	► **No property damage[1]** ► **No bystanders or motorists injured/killed** ► **Roadway is quickly cleared**
ENVIRONMENTAL VARIABLES	► **Topography** ► **Buildings & Structures (residential, commercial, areas)** ► **Lighting & Time of Day** ► **Weather (temperature, wind, precipitation, humidity)**	► **Subject(s), motorists & bystander(s)** ► **Visibility, traffic and road conditions** ► **Type of vehicles and/or cargo**

PRIMARY OBJECTIVE	CURRENT OPTIONS	RELEVANT CAPABILITIES	LIMITATIONS	CAPABILITY GAPS
Target vehicle stopped	**Tire deflation devices (TDDs)**	**Puncture tires**	**Does not stop**	**Cannot stop when and where LEOs want** **Cannot use tools that incapacitate drivers – they must be able to maintain control**
	P.I.T. Maneuver	**Spinouts**	**Spinouts** **Can continue**	
	OnStar (cooperative technologies)	**Slow vehicle to a stop**	**Limited vehicles** **Prior consent**	

[1] Excludes suspect vehicle

OPERATIONAL SCENARIO 7

SITUATION	**CORRECTIONS – PRISON RIOT (RELATIVE FREQUENCY = 5%)**	
DESCRIPTION	Approximately 100 inmates have divided along racial lines and are rioting. The inmates are throwing debris at each other. Some are engaged in one-on-one or group fights as members of each faction attempt to flee to the relative safety of their "own lines." Some inmates are seen breaking out light fixtures to make weapons while still others are observed to be armed with shanks, but they are only using them to hold other inmates at bay. All staff is out of immediate harm's way. Inmates are ignoring verbal commands to stop fighting.	
DESIRED OUTCOME (PRIMARY OBJECTIVE)	► **Inmates under control** ► **Inmate minimal injury (temp)** ► **No officer injured/killed**	► **No escapes** ► **Minimal, if any, damage to facility**
ENVIRONMENTAL VARIABLES	► **Adjacent geographical Features & Vegetation** ► **Buildings & Structures (Floor plan, HVAC, etc.)** ► **Lighting & Time of Day** ► **Visibility and noise**	► **Weather (temperature, wind, precipitation, humidity)** ► **Subject(s) & bystander(s) (size, density, proximity, emotion, etc.)** ► **NLW countermeasures**

PRIMARY OBJECTIVE	CURRENT OPTIONS	RELEVANT CAPABILITIES	LIMITATIONS	CAPABILITY GAPS
Inmates controlled	**Impact munition**	**Pain Precision**	**Pain is subjective Line-of-sight system**	**Pain compliance, which can be resisted by suspects, merely coerces them to desired behavior. There are no control devices for uncooperative subjects.**
	OC	**Pain Disorientation**	**Agitation Cross contamination Decontamination**	
	CS	**Pain Disorientation**	**Cross contamination Decontamination**	
	Distraction Device (balls)	**Disorientation**	**Very temporary effect**	
	CEDs	**Pain Incapacitate**	**Range Problematic in deploying in crowds**	

OPERATIONAL SCENARIO 8

SITUATION	**CORRECTIONS – PRISONER DISORDER (RELATIVE FREQUENCY = 8%)**	
DESCRIPTION	Two inmates locked in a holding cell are fighting. They ignore all orders to cease. One inmate appears to be gaining the upper hand.	
DESIRED OUTCOME (PRIMARY OBJECTIVE)	► **Inmates under control** ► **Inmates minimal injury (temporary)** ► **No officer injured/killed**	► **No escapes** ► **Minimal, if any, damage to facility**
ENVIRONMENTAL VARIABLES	► **Buildings & Structures (Floor plan, HVAC, etc.)** ► **Lighting and visibility** ► **Noise** ► **Other inmates or staff in the area**	► **Temperature and humidity** ► **Nature of subjects' conditions (size, emotional and physical state, etc.)** ► **NLW countermeasures**

PRIMARY OBJECTIVE	CURRENT OPTIONS	RELEVANT CAPABILITIES	LIMITATIONS	CAPABILITY GAPS
Inmates controlled	**Impact munition**	**Pain** **Precision**	**Pain is subjective** **Line-of-sight system**	**Pain compliance, which can be resisted by inmates, merely coerces them to desired behavior.** **They do not actually "control" a subject (other than CEDs).**
	OC	**Pain** **Disorientation**	**Agitation** **Cross contamination** **Decontamination**	
	CS	**Pain** **Disorientation**	**Cross contamination** **Decontamination**	
	Distraction Device (balls)	**Disorientation**	**Very temporary effect**	

OPERATIONAL SCENARIO 9

SITUATION	**CORRECTIONS – PRISONER TRANSPORT (SINGLE INMATE)**			
DESCRIPTION	Two correctional officers (COs) are transporting a medium risk prisoner to the hospital. The prisoner was complaining of extreme pain in his left ankle and chest. The hospital emergency room doctor examined the prisoner and found nothing remarkable about his condition. The prisoner was discharged. While being placed in the sedan transport vehicle, the prisoner knocked one CO down and ran off toward a neighboring wooded area. Both COs gave foot pursuit and captured the Prisoner quickly. Restrained only by a restraint belt and handcuffs, the prisoner fought with both COs. The sheriff's department responsible for patrolling this rural area would not be able to have an assisting deputy on scene for 45 minutes. Every step toward the transport vehicle was a fight with the COs. Upon getting the prisoner back into the transport vehicle, the prisoner tried to kick out the windows and banged his head on the cage. The prison is an hour away through rural country.			
DESIRED OUTCOME (PRIMARY OBJECTIVE)	► **Inmate under control** ► **Inmates minimal injury (temporary)** ► **No officer injured/killed**		► **No escapes** ► **Minimal damage to facility**	
ENVIRONMENTAL VARIABLES	► **TRANSPORT VEHICLE** ► **Lighting, visibility, noise**		► **NLW countermeasures** ► **Weather, etc.**	
PRIMARY OBJECTIVE	**CURRENT OPTIONS**	**RELEVANT CAPABILITIES**	**LIMITATIONS**	**CAPABILITY GAPS**
Subject controlled	**Impact munition**	**Pain** **Precision**	**Pain is subjective** **Line-of-sight system**	**Pain compliance, which can be resisted by inmates, merely coerces them to desired behavior.** **These options do not control, certainly not for 45 minutes.**
	OC	**Pain** **Disorientation**	**Agitation** **Cross contamination** **Decontamination**	
	CS	**Pain** **Disorientation**	**Cross contamination** **Decontamination**	
	CEDs	**Pain** **Incapacitate**		

OPERATIONAL SCENARIO 10

SITUATION	**CORRECTIONS – PRISONER TRANSPORT (BUS/MULTIPLE INMATES)**	
DESCRIPTION	A prisoner transport bus is transporting 40 inmates from one state to another as per an agreement for housing prisoners. The inmates are all classified medium security. The prisoners are handcuffed and attached to other prisoners on a four prisoner chain. There are two correctional officers on the bus as well as the driver. While still in the originating state (two hours into a six hour trip), on a divided lane interstate highway, two of the inmates become involved in a fist fight. They are in the middle of the bus. As they are fighting, six others are joining in and the whole inmate population is cheering them on. The COs have notified 911 via cell phone of their location, speed, destination, and desire to remain mobile until enough help has arrived. The State police are responding with an estimated time of arrival of 25 minutes for the first Trooper.	
DESIRED OUTCOME (PRIMARY OBJECTIVE)	► **Inmates under control** ► **Inmates minimal injury (temporary)** ► **No officer injured/killed**	► **No escapes** ► **Minimal damage to facility**
ENVIRONMENTAL VARIABLES	► **TRANSPORT VEHICLE** ► **Lighting and visibility** ► **Noise**	► **Temperature and humidity** ► **Nature of subjects' conditions (size, emotional and physical state, etc.)** ► **NLW countermeasures**

PRIMARY OBJECTIVE	CURRENT OPTIONS	RELEVANT CAPABILITIES	LIMITATIONS	CAPABILITY GAPS
Subject controlled	**Impact munition**	**Pain Precision**	**Pain is subjective Line-of-sight system**	**Need to be able to restore order without effecting surrounding environment (roadway) while remaining mobile**
	OC	**Pain Disorientation**	**Agitation Cross contamination Decontamination**	
	CS	**Pain Disorientation**	**Cross contamination Decontamination**	
	Distraction Device (balls)	**Disorientation**	**Vehicle mobile Very temporary effect**	

OPERATIONAL SCENARIO WORKSHEET

SITUATION	**TITLE:** **(RELATIVE FREQUENCY = ____%)**			
DESCRIPTION				
DESIRED OUTCOME (PRIMARY OBJECTIVE)	▶ ▶ ▶ ▶	▶ ▶ ▶ ▶		
ENVIRONMENTAL VARIABLES	▶ ▶ ▶ ▶	▶ ▶ ▶ ▶		
PRIMARY OBJECTIVE	**CURRENT OPTIONS**	**RELEVANT CAPABILITIES**	**LIMITATIONS**	**CAPABILITY GAPS**

ANNEX B

GLOSSARY OF TERMS

Accuracy	An accurate munition is one that impacts near the point of aim. Accuracy is also described mathematically as the distance between the MPI of a number of munitions and the point of aim. Inaccurate munitions result from random error (e.g., changes in wind speed/direction). Although one might use MPI to describe an instance of high precision and low accuracy, the reverse is not true – it is not possible to reliably achieve accuracy without some level of precision.
Applicable Response	Response determined appropriate for a given operational scenario.
Basis Response	Generic responses that describe how targets behave as the result of the application of a weapon or technology [or tactic, or procedure] employed against them. The seven Basis Responses identified are Mobility, Communications, Physical Function, Sense and Interpret, Group Cohesion, Motivation, and Identification.
Flexible Baton	A square, rectangular, or circular fabric bag containing shot (normally lead). The round is intended to flatten on impact, hitting face on, and spread its energy over a large area. These rounds are intended to be fired directly at an individual.
Conducted Energy Device (CED)	Electrical device that uses the effects of electricity conducted along a pathway or medium to incapacitate a subject. The effects are largely induced muscle tetany and described as electro-muscular disruption.
Communications	The ability to disrupt or control by either restricting or enhancing verbal communication via voice or gestures between targeted subjects.
Commercial Off-The-Shelf (COTS)	Describes commercially produced and available items procured for police or military use often through civilian contractors.
CS Gas	A chemical compound, commonly referred to as "tear gas," that is used as a riot control agent (RCA). *(2- Chloro-benzalmalononitrile)*

Deadly Force	All use of force techniques used by an officer that the officer knows, or reasonably should know, create a substantial risk of causing death or great bodily harm.
Debilitating	Degraded function to a point of inability to present a threat. Considered by degree, but only partially or not completely incapacitating.
Description	Brief summary of the context of the operational scenario.
Discriminating Chemical Delivery Devices or Rounds.	These devices/rounds can be used to deliver a quantity of chemical irritant (e.g., CS) to a target at a range further than is possible using conventional hand held sprays (10-15 feet). These tend to combine kinetic impact effects with chemical irritant effects to produce incapacitation of the target.
Duration of the Target Effect	The period after the onset time that the target should exhibit a particular response greater than some particular threshold.
Effective	Normally achieves the operational (field) performance objective.
Electrified Riot Shields	These polycarbonate shields with electrical contacts fitted to the edges or surface can be supplied as a unit or the electronic package can be modified to mount on other types of non-conductive riot shields.
Encapsulated Rounds	These include projectiles that contain a liquid, powder, or other material within a protective coating or shell. Upon impact, the contents are dispersed.
Environmental Factors	Environmental factors (for example, wind speed, temperature, humidity) drawn from a scenario or personal context, directly affect the performance of a given weapon system [or tactic, or procedure] and consequently the system's calculated Measures of Performance.
Excited Delirium Syndrome (ExDS)	An altered mental state with impaired cognition, impaired perception, and severe psycho-motor agitation.
Fin-Stabilized Rubber Projectile	A single rubber round with a finned tail to aid stability in flight. These rounds are intended to be fired directly at a subject.
Great Bodily Harm	Bodily injury which creates a high probability of death or serious injury, or may result in permanent disfigurement, a permanent or protracted loss or impairment of the function of any bodily member or organ, or other serious bodily harm.

Group Cohesion	The ability to disrupt or control a group of individuals or cooperatively operating vehicles, vessels or aircraft by either restricting or enhancing their organization, cooperation, and density.
High Order Explosives	Explosive materials that detonate (the explosion is supersonic). Federal explosive law and regulations do not differentiate between "high" and "low" explosives.
Identification	The ability to differentiate between various individuals, groups of individuals, vehicles, vessels, or aircraft through an identifiable designation.
Impact Velocity	Velocity of a projectile at or near impact.
Impact Weapons	Objects and instruments that are used, or are designed to be used, to apply force to the person of another by coming into physical contact with that person.
Incapacitating	Causes temporary and total dysfunction and a complete inability to perform basic aggressor functions or pose a threat.
Incapacitation	Degraded human function or physical/sensory dysfunction that is temporary and of such a degree that an individual is rendered incapable of carrying out any violent physical act.
Kinetic	Of, or relating to, the motion of material bodies and the forces and the energy associated with that motion.
Kinetic Energy (KE)	The energy which a body possesses by virtue of its motion. The kinetic energy (KE) of a mass (m), moving with velocity (V), is equal to $\frac{1}{2}mV^2$.
Kinetic Energy Rounds	This generic category includes sponge grenades, flexible batons, sock rounds, single and multiple ball rounds, fin-stabilized rubber projectiles and baton rounds.
LASER	Light Amplification by Stimulated Emission of Radiation
LASER/Light Devices	The effects of bright light/LASER devices can range from dazzle or glare to image formation, flash-blindness and irreversible damage. These devices are considerably less effective in daylight or in the presence of strong artificial light.
Less-Lethal	The application of tactics and technologies which are less likely to result in death or serious injury than conventional firearms and/or munitions.

Low Order Explosives	Explosive materials that deflagrate (the explosion is subsonic). Federal explosive law and regulations do not differentiate between "high" and "low" explosives. Sound Flash Diversionary Devices are considered Low Order Explosives.
Magnitude of the Target Effect	The qualitative or quantitative response that the target should display once the weapon system [or tactic, technique, or procedure] has taken full effect.
Maximum Effective Range (RG_{ME})	The maximum distance at which a particular weapon/device can be expected to be used within the precision and accuracy parameters set or at which the desired effect can be reliably anticipated.
Measures of Effectiveness	Measures indicating the degree to which a subject or target response satisfies a requirement within an operational context.
Measures of Performance	Measures showing how environmental factors influence weapon effects at the subject or target.
Measures of Response	Measures indicating how a subject responds (or target reacts) to a system's effects.
Mechanical	Relating to, governed by, or in accordance with the quantitative relations of force and matter; caused by, resulting from, or relating to a process that involves purely physical as opposed to chemical change.
Minimal Force Options	A broader interpretation of the tactics, techniques, or technologies available and intended for other-than-deadly force applications. This term is more comprehensive than "less-lethal" and conveys the idea that the force (tactic, technique or technology) applied will be commensurate with the threat.
Minimum Safe Range (RG_{MS})	The range short of which the application has the potential to cause unintended or more serious and potentially life threatening injuries. Ideally, this range should be zero (i.e., muzzle safe).
Mobility	The ability to disrupt or control the speed and/or direction of movement of subject or target.
Motivation	The ability to disrupt or control the target(s) by either restricting or enhancing their will to act in certain ways in order to achieve a goal.

Mean Point of Impact (MPI)	The point whose coordinates (*x,y position*) are the arithmetic means of the coordinates of the separate points of impact of a finite number of projectiles fired at the same aiming point under a given set of conditions.
Multi-Ball Rounds	Also known as pellets, a single cartridge can contain from 2 to over 200 pellets, each varying in size from about 0.25 to over 0.75 inch (6–19mm). These rounds can be fired directly or skip-fired off a hard surface in front of a subject. They can be used to target a number of people together and are not as discriminate as many other impact rounds.
Multi-Baton Rounds	These generally consist of 3 or 5 batons in a single cartridge, generally made from rubber, wood, or foam. These rounds can be fired directly or skip-fired in front of a subject. As the batons spread during flight, these tend not to be as discriminate as other rounds.
Muzzle Velocity	Velocity of a projectile at or near the muzzle of the weapon.
Muzzle Velocity Variation (MVV)	Standard deviation in the muzzle velocity of a number of firings of the same munition. Often expressed as a percentage (standard deviation in muzzle velocity with respect to the average muzzle velocity of a number of rounds).
Non-Deadly Force	Force used by an officer that does not have the purpose, nor create substantial risk, of causing death or great bodily harm.
Non-Lethal (NL)	Term used by the military aligned to NATO and in U.N. documents. A strict interpretation of the term implies a weapon, system, or technology designed with the intent of not causing serious injury or death. Synonymous with law enforcement term “Less-Lethal.”
Oleoresin Capsicum (OC)	Also known as “pepper spray,” OC is generally made from organic materials and is FDA-approved for sale over-the-counter in the United States. Some products contain (all or in part) synthetic capsaicin such as Nonivamide. Causes severe and immediate burning sensation to mucous membranes when sprayed into face, nose, and eyes.
Onset Time	The period between the deployment of the weapon system [or tactic, technique, or procedure] and the point when the magnitude of the desired effect attains some particular threshold. Ideally, onset time is normally equal to zero.

Physical Function	The ability to disrupt or control by either restricting or enhancing the capacity of subject(s) to accomplish tasks or the physical state of equipment such that it is inoperable of functions at reduced efficiency.
Physical Weapon Characteristics	The intrinsic qualities of a weapon including dimensional design values associated with a weapon (weight, caliber, size, power requirement, shelf life, etc).
Precision	Precision is the degree of dispersion or scatter of munitions when aimed at the same point (i.e., shot group size). A precise measurement is one that has very little scatter. Precision is a function of the distance between successive impact points and the mean point of impact (MPI) of a number of munitions. A lack of precision can be attributed to inherent errors (e.g., consistency in manufacturing process). This is arguably the most important attribute for launched munitions. Users must determine their requirement for precision and should consider only those munitions that achieve such precision at operationally significant ranges.
Riot Control Agents (RCAs)	Despite their name, these agents have much broader tactical application for law enforcement than crowd management and riot control. They include malodorants, irritants, smoke, marking agents, and calmatives. They are used in distraction (individual), deception (tactical), disruption (activity), dispersal (crowd), disorientation (individual or group), disablement (individual or group), and/or denial (area/vehicle/facility).
Required Outcome	The required outcome (RO) considers the entire operational context of a mission or scenario. It reflects the accomplishment of multiple tasks and the satisfaction of associated constraints over time.
Required Response	The response required of a selected subject or target for scenario success. It links a particular target engagement with a weapon or technology at a particular time in the scenario or mission. Specified in terms of values for each of the seven basis responses: desired onset time; desired magnitude of target effect; desired duration; and desired target recovery.
Relative Frequency	The expected frequency of occurrence of a scenario relative to all operational scenarios.

Sense and Interpret	The ability to disrupt or control by either restricting or enhancing the vision, smell, hearing and cognition of target(s) or the operation of artificial intelligence systems in autonomous vehicles, vessels, or aircraft.
Serious Injury	Injury that requires invasive and extensive medical treatment and/or surgery and results in permanent physical damage to the individual.
Single Flexible Ball Round	This consists of a single ball (generally rubber or plastic) of various sizes, which may deform on impact to spread the energy over a larger area. These rounds are intended to be fired directly at an individual.
Situation	Title or short description of an operational scenario.
Sock Round	A modification of the flexible baton, designed to have no edges or corners which could lead to penetration, and tending to have a "tail" to aid stabilization in flight. These rounds are intended to be fired directly at an individual.
Stun Batons	Stun batons are like standard police batons with an added electrical component. The batons generally have probes attached to the front end. When the probes are touched against a person, the trigger is pulled to deliver a shock. Some versions also have metal bands running part-way along or up the entire length of the baton. In these cases, if a person grabs the baton along its length, they will receive a shock.
Stun Guns	Category of CED. Hand-held units generally ranging in size from 4 inches to nearly 9 inches in length and weighing between 8 and 12 ounces, including the batteries. The probes or electrodes that deliver the electricity are permanently connected to the unit. These probes are not generally designed to penetrate the skin of the target, but are intended to be held close up to the body to allow the flow of charge.
Target Recovery	The period when the target response falls below a particular threshold and a full recovery of unimpaired functionality is desired in an operationally meaningful context. In many instances, this would ideally mean full recovery immediately at the end of the desired duration.
TASER©	A conducted energy device. The name is an acronym taken from a comic book device—Thomas A. Swift Electric Rifle. Trademark name for the leading developer and manufacturer of conducted energy devices (TASER International).

Use of Force	Use of force is any contact applied by an officer that significantly restricts or alters the actions of another and/or compels compliance with the demands or instructions of the officer. This includes the use of restraint devices such as handcuffs.
Use-of-Force Policy	A standard that provides guidance to law enforcement and corrections officers regarding the amount of force that may be used against a resisting subject in a given situation. These policies are often illustrated with use-of-force models, continuums or other graphical aids the purpose of which are to facilitate officer training regarding application of the policies in dynamic and stressful operational situations.
Water Cannon	Water cannons project a continuous stream of water to deter aggressive individuals and crowds. Many countries currently employ the water cannon and others are exploring the utility of these and portable water cannon.
Weapon	Any instrument used, or designed to be used, to apply force to the person of another.

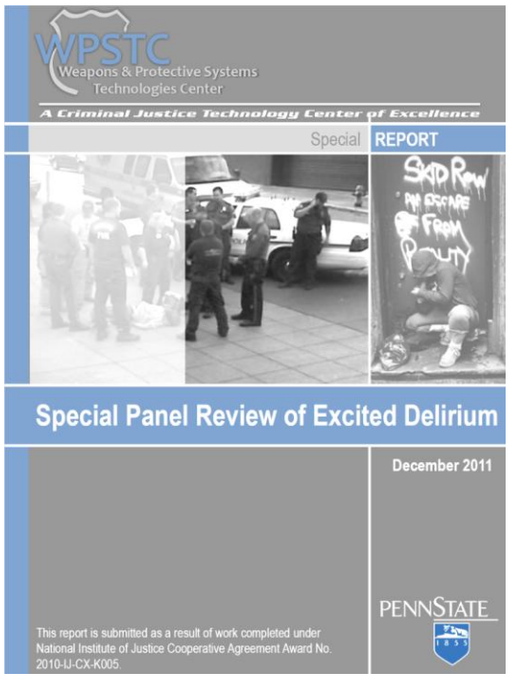
ANNEX C

EXCITED DELIRIUM SYNDROME (ExDS)

General

In 2011, the Weapons and Protective Systems Technologies Center convened a special panel to examine the subject of Excited Delirium Syndrome (ExDS) and the interventions being cooperatively developed by the law enforcement and medical communities.

The purpose of the meeting was to examine the phenomenon and its association with the use-of-force in general and the use of CEDs in particular. The panel also reviewed, discussed, and examined some first responder protocols.



2011 REPORT: A Special Panel Review of Excited Delirium

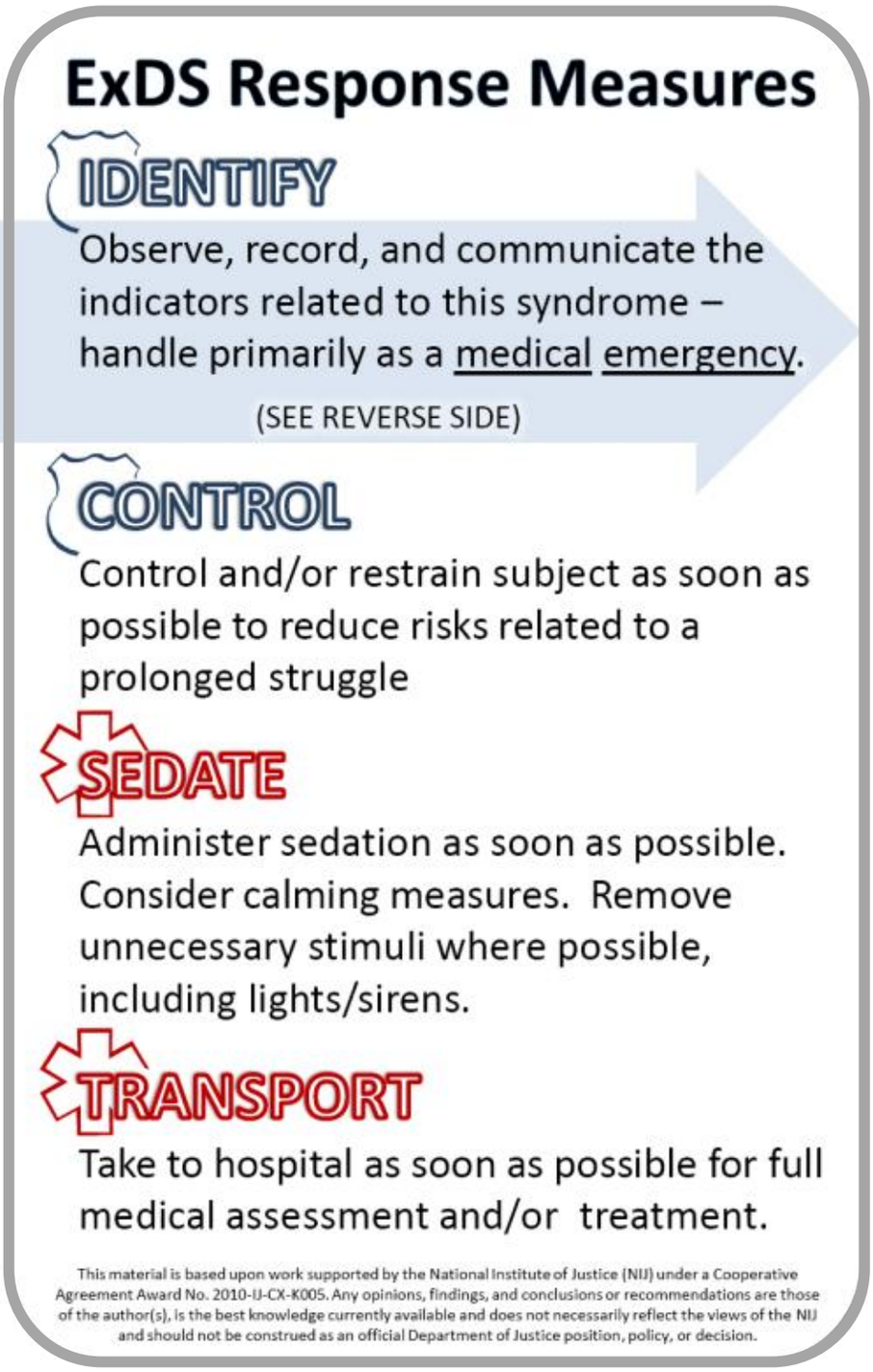
The panel agreed upon an acceptable definition for ExDS: "An altered mental state with impaired cognition and perception, and severe psycho-motor agitation." This is consistent with the definition derived by the Excited Delirium Task Force commissioned by the American College of Emergency Physicians (ACEP) in 2009.

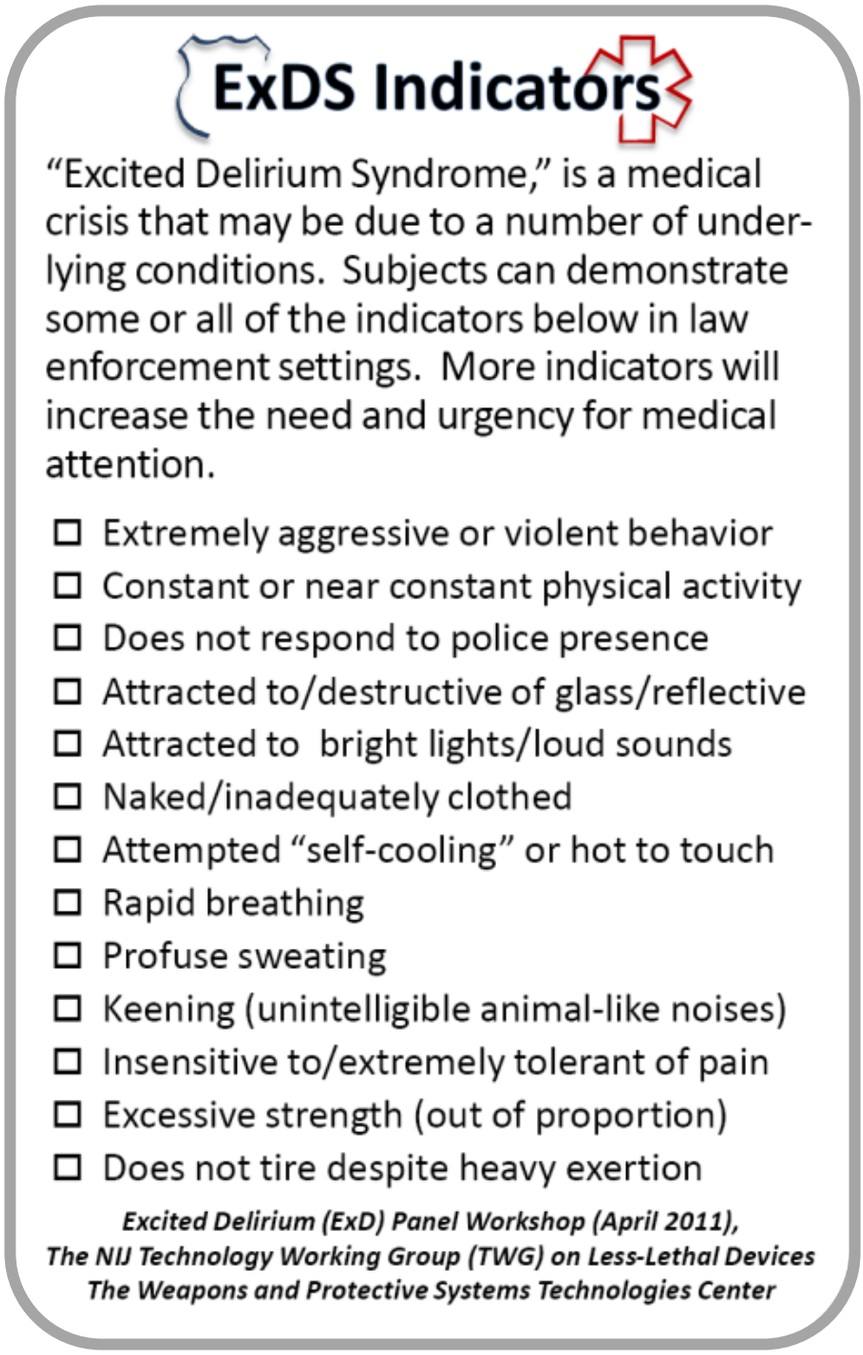
ExDS Steps and Indicators

The panel also arrived at a general consensus on basic steps for first responders dealing with ExDS cases. These generally adhere to those decribed by the ACEP ExDS Task Force. The indicators below are based on findings in the medical literature and have been reproduced on the quick reference card agreed upon by the panel. As mentioned, these may not present themselves uniformly, due to varied underlying medical conditions that may generate ExDS. Some signs and symptoms are more significant, and more common, than others.

- ✓ Clear ***identification*** of ExDS cases based on common signs and symptoms (indicators) of the syndrome;
- ✓ Rapid ***control*** of the individual with adequate law enforcement personnel;

- ✓ ***Sedation*** by emergency medical personnel immediately after the subject is under police control;
- ✓ ***Transport*** of the subject to a medical facility for follow-up treatment and evaluation; and documenting the case.





It was the consensus of the panel that use of signs/symptoms based on medical literature provides law enforcement with more comprehensive criteria for determining a medical emergency; uniform criteria for agencies implementing such protocols across jurisdictional boundaries; and better defensibility. Following the meeting, the panel arrived at a general consensus for a revised list of indicators for the quick-reference card (above).


WPSTC
Weapons & Protective Systems
Technologies Center