Non-lethal weapons are not a new phenomenon; the idea of forcing an enemy to bend to your will without killing him is as old as war itself. On the other hand, the technology of non-lethal weapons has changed greatly, especially over the past couple of decades. Concurrently, information technologies have advanced as well, resulting in near real time transmission of wartime events to the rest of the world. This has enhanced public aversion, and an instant reaction, to "unnecessary" death and collateral damage, which have had at times negative and drastic strategic effects. Additionally, the destruction caused by war inevitably serves to make stabilization and reconstruction that much more difficult for the victor once peace has broken out. The technology exists now and in the future whereby militaries who operationalize non-lethal weapons systems can achieve their tactical and operational objectives while promoting and legitimizing their strategic aims.

**Subject Terms**
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FUTURE WAR PAPER

TITLE:
Non-Lethal Weapons and the Future Battlespace: The Right Choice for the Right Effect

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR THE DEGREE OF MASTER OF OPERATIONAL STUDIES

AUTHOR: Major Corey Frederickson, PPCLI (Canada)

AY 2012-13

Mentor: Dr. Wray R. Johnson
Approved: ____________________________
Date: 87 March 2013
Executive Summary

Title: Non-Lethal Weapons and the Future Battlespace: The Right Choice for the Right Effect

Author: Major Corey Frederickson, PPCLI (Canada)

Thesis: Modern militaries can better achieve strategic aims through the employment of non-lethal weapons. In the near future, military units, equipped with non-lethal arms as their primary weapon systems, can provide military commanders with a viable alternative to deadly force capabilities.

Summary: Non-lethal weapons are not a new phenomenon; the idea of forcing an enemy to bend to your will without killing him is as old as war itself. On the other hand, the technology of non-lethal weapons has changed greatly, especially over the past couple of decades. Concurrently, information technologies have advanced as well, resulting in near real time transmission of wartime events to the rest of the world. This has enhanced public aversion, and an instant reaction, to "unnecessary" death and collateral damage, which have had at times negative and drastic strategic effects. Additionally, the destruction caused by war inevitably serves to make stabilization and reconstruction that much more difficult for the victor once peace has broken out. The technology exists now and in the future whereby militaries who operationalize non-lethal weapons systems can achieve their tactical and operational objectives while promoting and legitimizing their strategic aims.
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Introduction

When considering the ends, ways, and means of strategy to achieve a political goal, it is generally accepted that tactical actions are synchronized in order to achieve strategic ends. In other words, tactical actions bring about strategic results. The converse is also true; failed or ill-advised tactical actions can ensure that strategic ends are NOT met, and therefore neither are the political goals. Of particular importance to the achievement of political goals is the notion that, more than anything, politics is perception. Politics is less about the reality of any given situation than it is about what the reality is perceived to be, both at home and abroad. Many a policy and politician have failed because of some small misperception that grew into a political reality. In that regard, the people of a nation have an expectation that their government and military will go about their business in a certain way. In the West, this "way" implies capability and competence, balanced with fairness and justice. In this light, tactical actions, properly considered and conducted in a manner consistent with these values, can ensure that strategic ends are achieved and therefore the political goals as well. One method to competently and fairly obtain strategic ends is through the employment of non-lethal weapons. This paper asserts that modern militaries can better achieve strategic aims through the employment of non-lethal weapons. It further postulates a near future where military units, equipped with non-lethal arms as their primary weapon systems, may provide military commanders with a viable alternative to deadly force capabilities.

At this point it is best to define what is meant by the term non-lethal weapon. The United States Joint Non-lethal Weapons Directorate states that such weapons are "devices and munitions that are explicitly designed and primarily employed to incapacitate targeted personnel or materiel immediately, while minimizing fatalities, permanent injury to personnel, and undesired damage
to property in the targeted area or environment. NLW are intended to have reversible effects on personnel or materiel.\textsuperscript{1} Of course by definition no weapons are truly non-lethal; rubber bullets can kill if fired close enough to a target and if the round impacts a vulnerable area, chemical gases can have adverse effects, and electricity employing weapons can stop the heart of a target (especially if there are pre-existing health problems). In fact, the age and physiology of the target can have as much to do with lethality as the weapon itself. Nevertheless, as retired US Army Colonel John B. Alexander notes, “It is recognized that some level of fatalities will occur with any system devised by man. The important difference between lethal and non-lethal systems is that NLWs are designed with the intent of allowing application of force while minimizing the probabilities of fatalities [emphasis in original].”\textsuperscript{2} While this distinction of intent may well be lost on the intended targets of non-lethal weapons, it is sufficient for our purposes to differentiate them from lethal systems.

**Why Non-Lethal Weapons?**

Since the invention of war, mankind has probably debated the morality of killing in war. When is killing morally justified, if ever? Is one method of offering violence more morally acceptable than another? There are those who believe that man has advanced far enough to render killing unnecessary and therefore obsolete.\textsuperscript{3} Nevertheless, this paper will not delve into the morality of killing but will instead take a pragmatic approach to war. It is assumed that Nathan Bedford Forest was right -- at least partially—that “War will mean fighting, and fighting means killing.” War does mean fighting, but does fighting necessarily have to mean killing? If one accepts, as Carl von Clausewitz did, that “War is thus an act of force to compel our enemy to do our will,”\textsuperscript{4} then war probably involves killing. But one can also argue that it is not always necessary to kill in order to coerce a change in behavior (after all, how can we bid an enemy to
do our will if the enemy is dead?). In fact, killing in war can be counter-productive and threaten the achievement of our strategic aims.

Western societies, particularly in recent decades, have become very casualty conscious. People have always been concerned with the deaths of their own sons and daughters in battle, but now those same civilians are concerned about the enemy forces and especially the neutral civilians who are killed by their soldiers in their names. In what was popularly known in the 1990s as the “CNN effect” that is, because of live 24-hour news Western societies are now immediately and intimately aware of the death and destruction wrought by their armed forces, often with graphic photographic and video evidence to prove it. This has become even more prevalent of late with the advent of smart phones with camera technology as well as the proliferation of social media such as YouTube and Twitter. Right or wrong, today’s citizens form their opinions based on what they see and respond with varying forms of political pressure.

As mentioned before, this paper will not judge the righteousness of killing in the name of policy, but a nation’s citizens certainly will. It is therefore necessary to be aware of and sensitive to public opinions if any democratic leader wishes to remain in office.

The public opinion mentioned above relates to domestic attitudes, but of course there are other opinions to take into consideration -- that of the local populace where conflict occurs. Military officials usually do their best to minimize collateral damage to civilians during conflicts; indeed, some collateral damage is expected by planners and leaders and indeed for by international law. Again, that is the pragmatic view. But the emotional reaction of the Afghani mother cradling her child who died accidentally as the result of a NATO air strike will likely not be so accommodating. From 2007 to 2011, almost 12,000 civilians were killed in the conflict in Afghanistan. During the first six months of 2011 alone, at least 1,145 civilians were killed and
another 1,945 were wounded. Interestingly, it is estimated that only ten percent of these casualties were caused by international and pro-government forces; nevertheless, this statistical disparity is not often noted by the local population. Anti-Western protests erupt very quickly after any incident involving civilian deaths or injuries. Afghan President Karzai himself has warned that civilian casualties will impair cooperation and ultimately the mission in Afghanistan. But despite precision weapons and restraint, civilian casualties continue to occur. Clearly, reducing civilian casualties is imperative to reduce the animosity that is almost always felt by civilians toward foreign occupiers, animosity that is encouraged, manipulated, and magnified by insurgents.

Excessive civilian casualties resulting from lethal force are not the only factors that can contribute to strategic failure. Ironically, being too successful in military operations can, in the long run, be detrimental to the desired end goal. Sun Tzu wrote, “In the practical art of war, the best thing of all is to take the enemy’s country whole and intact; to shatter and destroy it is not so good. So, too, it is better to recapture an army entire than to destroy it, to capture a regiment, a detachment or a company entire than to destroy them.” Sun Tzu was thinking about post-conflict reconstruction. If an invader spares the enemy army, then it has a ready-made security force after the conflict. If an invader destroys the enemy army, it will be forced to conduct security operations itself (Iraq being the most recent example). Moreover, if an invading army spares the local infrastructure and refrains from killing skilled workers, then it becomes much easier to stabilize the country and accelerate reconstruction. While the short term goals may indicate that destruction is required, often the long term goals will dictate that limiting destruction is much more beneficial. Another reason to limit casualties is intelligence. Put simply, dead men provide little meaningful information. This is perhaps particularly applicable
in counterinsurgency operations, but it remains valid “full-spectrum” operations as well.

Generally speaking, and if at all possible, it is better to capture a potential source of information alive than dead.

To repeat an oft stated theme, it is better to limit the lethality and destruction of war in order to better achieve a strategic end. Clearly this is much easier said than done. All the same, reducing civilian casualties, minimizing destruction of infrastructure, and maintaining domestic support can all be realized through the judicial and systematic employment of non-lethal weapons. The question remains, however; is it possible to achieve the same ends through the use of non-lethal weapons as with lethal systems?

Discussion

The use of non-lethal weapons has been around for just as long as lethal weapons, although the concept as we currently understand it is a much more recent invention. For centuries, states have used non-lethal “effects” to augment or replace lethal means to achieve their aims. Smoke has long been used to conceal, disorient, and incapacitate. Counter-mobility obstacles such as moats, walls, and other obstructions were not in and of themselves designed to kill. Even the concept of deterrence, although generally backed by the threat of lethal force, is a non-lethal means to elicit a desired behavior.

It was only during the 1960s that an assortment of weapons technologies emerged, starting with chemical agents known as irritants, and became known collectively as “non-lethal weapons.” More recently there has been an explosion of non-lethal technologies. The use of electricity, acoustics, different polymers for ballistic ammunition, and the expanded use of chemicals are just a few examples (see appendix A). Even the use of cyber technology, while not strictly classified as a non-lethal weapons system, is capable of providing non-lethal effects.
In very real terms the development of non-lethal weapons systems is limited only by the realities of physical science, but also so by the realities of budgets and imagination.

Non-lethal weapons are generally classified into two categories, the first of which is counter-personnel. Counter-personnel systems are designed to deter, paralyze, or disable. They include chemical agents which can irritate, paralyze through neural inhibitors, or stimulate sleep. Other chemicals can induce vomiting or produce an odor so foul that people cannot stand to remain in the area. Optical counter-personnel weapons include low energy lasers which temporarily blind or disorient a person, while “flash” weapons (i.e. flash-bang grenades) accomplish the same. Acoustic weapons use low frequency sound to disorient, cause discomfort, and/or create nausea. Restraining mechanisms, including sticky foams, nets, and lubricants, inhibit or prevent personal mobility. Electroshock weapons such as tasers and stun guns, provide an electric jolt that overwhelms the nervous system resulting in involuntary muscle contractions. “Kinetic” weapons use plastic and softened (beanbag) ammunition to limit injuries. Perhaps most interesting, directed energy weapons such as the High Powered Microwave known as the Active Denial System, project millimeter wave energy upon the water and fat molecules in the skin in the same manner that a household microwave heats a cold meal. The excited molecules produce heat which is felt as intense pain. The pain ceases immediately once the system is turned off or the target moves out of range.

The second category of non-lethal weapons systems is counter-material systems designed to disrupt or destroy (in the limited sense of the word) equipment, vehicles, and facilities. Chemical and biological agents can affect structures as well as people. Embrittlement agents change the molecular structure of specific metals, causing catastrophic failure. Chemicals that cause plastics to break down cause engines to clog and connectors to fail. The same foams,
adhesives, and lubricants that inhibit the movement of people apply to vehicles and aircraft as well. Small amounts of contaminants can render large amounts of fuels completely unusable. Finally, non-nuclear electromagnetic pulses can be used to overload and destroy semiconductor devices to render inoperative any unshielded electronic device within the effective range of the pulse. 11

There are several new systems and technologies that are in varying stages of concept and development that offer intriguing future possibilities. Within the counter-personnel role, the United States Department of Defense (DOD) is developing a 40mm airburst flash bang munition that can be fired from the M203 grenade launcher to stun and incapacitate people. The Long Range Ocular Interruption Device is purported to be capable of blinding and disorientation effects at ranges up to 3,000 meters. Additionally under development is the Human Electro-Muscular Incapacitation Projectile. Fired from the M203, upon detonation it acts in the same manner as a taser or stun gun except that it is an area weapon and the leads are wireless. 12

Regarding counter-material technologies, the DOD is working on such projects as the Pre-Emplaced Electric Vehicle Stopper, which is employed in the same manner as a “spike strip” except that it overloads and shuts down electronic components within the vehicle. Also under development is the Multi-Frequency Radio Frequency Vehicle Stopper. As the name implies, it bombards a vehicle with radio waves, interfering with and shutting down the engine. 13 The effects are temporary and once the system is turned off, the target vehicle is able to move again under its own power. Civilian companies are concurrently working on creating non-lethal small arms ammunition that can be fired from existing lethal weapons.
Applications of Non-Lethal Weapons

Understanding the capabilities and the possibilities of individual non-lethal weapons systems is useful, but it is in imagining their application that the benefits become readily apparent. Of all the types of warfare, counter-insurgency (COIN) operations offer the most opportunities for the tactical and strategic employment of non-lethal weapons. Since COIN demands attaining the support of the local populace it necessarily follows that limiting civilian casualties and collateral damage to infrastructure is an as obvious intermediate goal. It is also during COIN that the paradigm can shift from non-lethal weapons systems as a “tool in the tool box” or an adjunct to lethal force to one where non-lethals are the primary systems and lethal force becomes the accessory.

For example, intelligence reports indicate that a group of insurgents is hiding in a small village, suggesting that a classic cordon and search operation is in order to capture the insurgents. Rather than implement such a classic approach, a non-nuclear electro-magnetic pulse could be delivered by manned aircraft or a drone, knocking out all electronic devices within range (cell phones, radios, video security systems, electronic detonators, vehicles, etc.). An outer cordon could also be put in place using the Active Denial System on the flanks to keep those outside the cordon from entering the village and to keep those inside the village within the corridor. The cordon can be strengthened by the use of the Pre-Emplaced Electric Vehicle Stopper and/or the Multi-Frequency Radio Frequency Vehicle Stopper to prevent any high speed entry to or exit from the village. Before the search begins, “calmative” agents can be dispersed that disorient or incapacitate anyone not wearing a gas mask. Security forces then enter the village using flash bangs, tasers, and netting projectiles, capturing the insurgents while leaving non-combatants merely dazed and confused but otherwise unharmed.
Imagine a second scenario wherein a patrol takes small arms fire from a flank. While immediately returning lethal fire and calling in artillery and gunships may achieve the desired effect of killing the enemy, it can also produce significant negative effects such as civilian casualties. Instead, the patrol can respond with airburst electric and gas munitions to subdue the attackers. They can then advance to contact and, using a suite of non-lethal weapons, capture the attackers alive while sparing the civilian population.

In the above examples, the tactical mission is successfully completed while the strategic aim is promoted by ensuring that civilian casualties and collateral damage are limited. Obviously, there will remain circumstances where lethal force will be required. Therefore, lethal weapons must not be abolished from the repertoire of response options. However, a unit outfitted with non-lethals as the primary weapon system, and properly trained on the same, will be a much more versatile and potent force in COIN operations than one with primarily lethal capabilities.

There is a tendency to think that non-lethal weapon systems are only useful in law-enforcement and COIN operations. However, the state of the technology today and in the future belies this notion. There are present and future non-lethal technologies that, when used in combination with lethal force, offer synergies of tremendous value. Non-nuclear electro-magnetic pulse and metal embrittlements are just two examples of non-lethal assets that can be used to achieve tactical, operational, and strategic results.

At the operational level of war, non-nuclear electro-magnetic pulse and metal embrittlements can be deployed by air or artillery over enemy concentrations to render tanks and other mechanized vehicles useless while having negligible effects on the crews. The same embrittlements sprayed over enemy ships may require their abandonment. Enemy airfields can
be sprayed with sticky foams or other inhibitors to prevent their use. Bridges, rail and transport hubs, and ports can be temporarily denied to enemy use through foams, lubricants, and odors. A temporary effect is useful because non-lethals avoid unnecessary destruction of enemy infrastructure that may prove an asset if used by friendly forces. For example, a bridge that was sprayed with sticky foam in order to prevent an enemy force from traversing it can be quickly restored to usefulness when friendly forces arrive by the application of solvents.14

At the strategic level of war, the very same non-nuclear electro-magnetic pulse and embrittlements can be used to strike at the heart of the enemy nation. Instead of destroying factories with high explosives, cruise missile deployed embrittlements can achieve the same end by damaging the infrastructure without loss of life. Instead of destroying government buildings and killing leaders and bureaucrats, use of non-nuclear electro-magnetic pulse (as well as cyber-attack) may render state control ineffective without unnecessary collateral damage. The same can be said for critical infrastructure. Non-lethal weapons such as odorants may be used to make facilities temporarily uninhabitable, allowing for future use and, perhaps more importantly, keeping alive the skilled and experienced operators. Introduction of contaminants to the enemy’s main fuel supply stores via special operations forces may cause the military and the nation to come to a grinding halt.

These above examples are not offered to claim that non-lethal weapons can fully replace lethal systems on the full spectrum battlefield – at least not yet. What they do offer, however, is a means to achieve some of the same tactical, operational, and strategic goals without undue loss of life. The advantage comes from using non-lethal weapons systems to better create the
conditions for a “better peace,” a worthy strategic endstate advanced by none other than Clausewitz himself.

**Issues in the Employment of Non-Lethal Weapons**

Obviously there is a downside to the employment of non-lethal weapons; otherwise they would be much more prevalent than they are at the present time. One might presume that the apparent advantages of minimizing death and destruction would make non-lethals the systems of choice. However, there are several obstacles that must be overcome before non-lethals are acceptable to policy-makers, the public, and military users as well.

First and foremost are the legal issues. In some cases, the very laws that were created to protect people are in fact dooming them to a worse fate. The world’s outrage at the use and effects of chemical weapons during the First World War has resulted in a string of conventions, most recently the Chemical Weapons Convention of 1993, designed to prevent their use. But technology has outpaced international law. Chemical weapons, (both lethal and non-lethal), are banned from use as a method of warfighting but non-lethal chemicals are not banned in other circumstances. In an odd twist, a nation is free to employ chemicals (within reason of course) such as riot control agents on its own civilians but is prevented from employing them against an adversary on the field of battle, despite the fact that the munitions are non-lethal. This technical prohibition may unnecessarily drive a combatant to select a lethal force option, even if lethal force is not the best practical option.

The United States has argued in the past for the use of non-lethal chemical weapons against enemy combatants -- for the purpose of saving civilian lives. Ironically, it is technically legal to use non-lethal chemicals on “foreign civilians” as long as the use is not a method of warfare, e.g. for riot control. Both examples illuminate the political and legal
minefields that many nations simply choose to avoid by employing lethal weapons. As long as international laws remain as they are, selection of the lethal option will be more expedient.

Closely tied to the legal aspects of non-lethal weapons is the moral argument. Non-lethal weapons are designed not to kill, but many are designed to inflict pain and discomfort. Such weapons can, therefore, be used for more nefarious purposes, such as torture.\textsuperscript{17} Tasers in particular are very useful for such purposes and, as a result, some have called for their prohibition as well. This is a common argument: ban something because it has the potential to be used in a manner beyond its intended purpose. However, this potential must be weighed against the benefits of the technology's true purpose. In this case, the life preserving use of Tasers (compared to lethal means) should out-weigh the potential that someone may use them for torture, especially when other technologies exist that can inflict similar pain such as cattle prods, jumper cables, etc.

Avoiding the infliction of pain and suffering is at the heart of the non-lethal argument. Not surprisingly then, lasers have come under much scrutiny because of their potential to permanently blind their targets. According to some, it is actually better to kill than to maim. The International Red Cross has attempted to counter this argument by claiming that all weapons that are certain to maim or kill are already banned (i.e., lethal chemical weapons, exploding bullets, etc.).\textsuperscript{18} However, this logic focuses on the nature of the weapon and not the intent of its designer or operator. If the intent is to maim so that one does not have to kill, then the choice of the less deadly use should be obvious.

Another argument against the use of non-lethal weapons is the "slippery slope" argument. The reasoning is that a nation that has non-lethal capabilities will be more likely to commit forces and become involved in hazardous situations because political leaders will perceive the
consequences to be less lethal. A linked argument is that of retaliation.\textsuperscript{19} An enemy who becomes the target of non-lethal weapons: 1) may not realize that the received attack used non-lethal means or the non-lethal intent behind the attack, and therefore retaliate with lethal means and/or 2) may not retaliate with non-lethal means (if capable) and may escalate to lethal means as the only alternative. Both of these arguments, while certainly within the realm of the possible, are rather esoteric in nature. Just because a nation can do something, it does not necessarily follow that it will do something.

There is also the problem of unintended consequences, that is, actions resulting in lethal outcomes despite non-lethal intent. A perfect example is the Moscow Dubrovka Theater hostage crisis of 2002. When Chechen terrorists took 900 Russian civilians hostage, Russian authorities negotiated for three days before pumping the theater full of gas and then assaulting the building. The result was that all 41 terrorists were killed (due to gunshot wounds) but also 128 civilians died as a result of the gas. The chemical fentanyl was used in aerosol form, which suffocated the victims, a tragedy that was compounded by delays in administering the antidote.\textsuperscript{20} It seems clear that the Russian security forces did not intend to kill the civilians, but that was the result nevertheless. One could argue that an assault sans gas would have resulted in even more civilian casualties. The opposite may be true too. We will never know. The point is that the specifics of the chemical compound are not germane to the argument. What is important is recognizing that non-lethal weapons are capable of killing. Accepting this fact, and exerting as much effort as possible to avoid killing is enough to justify their use.

In the end, perhaps the biggest obstacle to the employment of non-lethal weapons is the attitude of the users. To many military members, non-lethal weapons are inadequate and demonstrate moral weakness. To paraphrase Clausewitz, war is kill or be killed. But Clausewitz
also noted that discretion and restraint have always been a part of war. The art of war therefore includes knowing when to use lethal methods and when to use non-lethal methods.

**Recommendations and Conclusion**

In order for non-lethal weapons to be used to their fullest potential, the following must occur:

1. International laws and conventions must be amended such that non-lethal weapon systems may be used to prevent unnecessary death and destruction. Clarity and focus on the intent of the use of the weapon and not the nature of the weapon itself are key.

2. The attitudes of potential users must change. We must accept that non-lethal weapons are not just a minor part of the arsenal, but that there are many occasions when non-lethals should be the first option.

3. Militaries should experiment with the creation of a unit whose primary weapons systems are a suite of non-lethal technologies. This unit should train heavily in their use and be employed in some near future unconventional battlespace to gain empirical evidence of their utility.

4. Military commanders and planners must be educated about the tactical, operational, and strategic use of non-lethal systems and about their advantages in achieving policy goals.

Non-lethal weapons are not solely useful in law enforcement; they have clear military applications as well. Anything that can achieve the tactical mission without undermining the strategic political goals is an asset, and non-lethals fit the bill very well. While not every occasion will call for a non-lethal response, particularly in full spectrum operations in the near future, there remain many cases where restraint is called for, particularly in COIN operations.
That said, non-lethal weapons can and should play a larger role in achieving victory in all cases, not because it is morally the right thing to do but because it is the pragmatic thing to do.
### Appendix A - Non-Lethal Technologies

<table>
<thead>
<tr>
<th>Conductive Particles</th>
<th>Particles that can induce short circuits in electrical or electronic equipment</th>
</tr>
</thead>
<tbody>
<tr>
<td>Depolymerizing Agents</td>
<td>Chemicals that cause polymers to dissolve or decompose. Could clog air breathing engines. Adhesives could “glue” equipment in place.</td>
</tr>
<tr>
<td>Liquid-Metal Embrittlement Agents</td>
<td>Agents that change the molecular structure of base metals or alloys, significantly reducing their strength. Could be used to attack critical metal structures – aircraft, ships, trucks.</td>
</tr>
<tr>
<td>Nonnuclear Electromagnetic Pulse</td>
<td>Pulse generators producing gigawatts of power that could be used to explode ammunition dumps or paralyze electronic systems such as radars, communications, electronic ignition systems.</td>
</tr>
<tr>
<td>High-Powered Microwave</td>
<td>Generators that produce microwave pulses similar to electronic pulses. Microwave frequencies have anti-personnel applications that can cause pain or incapacitation.</td>
</tr>
<tr>
<td>POL Contaminants</td>
<td>Additives that cause fuel to jell or solidify, making it unusable.</td>
</tr>
<tr>
<td>Supercaustics</td>
<td>Acids that corrode or degrade structural materials.</td>
</tr>
<tr>
<td>Super Lubricants</td>
<td>Substances that cause lack of traction.</td>
</tr>
<tr>
<td>Acoustics</td>
<td>Very-low-frequency sound generators that can be tuned to incapacitate people.</td>
</tr>
<tr>
<td>Foam</td>
<td>Sticky or space-filling material that can impede mobility or deny access to equipment.</td>
</tr>
<tr>
<td>Isotropic Radiators</td>
<td>Conventional weapons that produce a flash that can dazzle people or optical sensors.</td>
</tr>
<tr>
<td>Lasers</td>
<td>Low-energy lasers that temporarily blind people or disable optical or infrared systems.</td>
</tr>
<tr>
<td>Calmative Agents</td>
<td>Chemical substances designed to temporarily incapacitate people.</td>
</tr>
</tbody>
</table>

Endnotes

1 Joint Non-Lethal Weapons Program, Non-Lethal Weapons Reference Book (Quantico, VA: JNLWD, 2012), i. (henceforth referred to as JNLWP)


10 JNLWP, 7.

11 Siniscalchi, 9.

12 JNLWP, 8-9.

13 JNLWP, 14-15.

14 Obviously this will be a less useful situation if the enemy were to have the required solvents to employ as well, but the primary objective of delaying the enemy could still be achieved nonetheless.


19 Alexander, 180.

20 Whitbred, 15.
Bibliography


