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The Development of “Non-Lethal” Weapons During the 1990’s.

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1. Introduction

This is the second in a series of Occasional Papers published by the Bradford Non-Lethal Weapons Research Project. It addresses the development of anti-personnel “non-lethal”¹ weapons from 1990 to 1999 and follows on from Occasional Paper No.1: *The Early History of “Non-Lethal” Weapons*.² Concentrating on events in the United States,³ this paper explores the expansion of police and military interest in these weapons with a focus on the research and development activities conducted by the Department of Justice and the Department of Defense. Related developments in international law are also discussed. “Anti-materiel” weapons, proposed for use against vehicles, electronic equipment, or other objects, are beyond the scope of this research.

This paper does not detail the debates over “non-lethal” weapons that intensified during this period and were marked by an increase in the corresponding literature. Nevertheless this is the background against which the research and development described here occurred. Fidler has observed that, broadly speaking, this debate was polarised with advocates on one side and sceptics on the other.⁴ The advocates⁵ emphasised what they viewed as the revolutionary or transformational promise of these weapon systems and their potential to promote the humane use of force. The sceptics,⁶ on the other hand, building on concerns first expressed in the 1970’s,⁷ cautioned against affording any weapons special status and highlighted the need for critical legal, technological and ethical assessment. Fidler has summarised a central theme of this enduring debate:

Nothing epitomized the distance separating advocates and sceptics better than disagreements about the moniker “non-lethal weapons”. For proponents, this description encapsulated the technological and ethical distinctiveness of these weapons. For sceptics, the moniker was misleading because it gave moral status to weapons simply by virtue of their technology and not on the basis of legal and ethical analysis of why, how and where they are used.⁸

2. Police Developments

At the beginning of the 1990’s the US National Institute of Justice (NIJ), the research arm of the Department of Justice (DOJ), continued to fund work at the US Army Edgewood Research Development and Engineering Center (ERDEC) on the development of incapacitating chemical weapons, having initiated the research effort in 1987.⁹ However, in 1992 the NIJ began to expand its’ Less-than-Lethal Technology (LTL) Program to cover a wide variety of potential weapons.¹⁰ As Pilant observed in a 1993 article: “In 1992 and 1993, the NIJ initiated cooperative agreements, interagency agreements and a series of grants that focused on finding out what police needed.”¹¹

In 1992 the NIJ enlisted technical support from the Department of Energy’s (DOE) Office of Intelligence for further development of “non-lethal” weapons through the Special Technologies Program.¹² This program at DOE was

primarily concerned with development of technologies to protect and secure nuclear facilities but it also encompassed the development of related 'counter-terrorism' technologies under projects funded by other government departments.¹³ Liaison with the DOE led to NIJ-funded projects on "non-lethal" weapons development at four of the DOE's national laboratories: Lawrence Livermore, Sandia, Oak Ridge and Idaho.¹⁴

At Lawrence Livermore National Laboratory in California, the NIJ funded further work on chemical incapacitating weapons as a follow-on project to the research that had been conducted by the Army. This work, at Livermore's Forensic Science Center, continued until at least 1997.¹⁵ At Sandia National Laboratory in Albuquerque, New Mexico, the NIJ funded projects to assess whether foams (sticky and aqueous) being used for securing nuclear facilities could be applied to use as "non-lethal" weapons by police.¹⁶ Sandia was the lead laboratory for research and development of physical security systems at the Department of Energy and a number of techniques were considered for impeding access,¹⁷ as described in a 1992 Office of Technology Assessment report assessing 'counter-terrorism' technologies:

Dispensable barriers and deterrents are designed to add physical encumbrances and to interfere with an adversary's personal sensory and motor processes. Such barriers include rapidly dispensable rigid foams, sticky foams, aqueous foams, sticky sprays, slippery sprays, sand columns, noise, lights, smoke, and rubble piles.¹⁸

At Oak Ridge National Laboratory an NIJ funded project on "non-lethal" weapons was initiated in September 1993, addressing "Physiological Responses to Energetic Stimuli".¹⁹ A history of police technology development, published by the NIJ in 1998, described the research as follows:

This project entails ongoing research ... into various technologies to produce temporary physiological responses, such as nausea, dizziness, and disorientation. Under study is the body's susceptibility to sound, light, and ionizing and non-ionizing electromagnetic waves. The goal of the project is to learn what the body reacts to and develop a device, tool, or weapon that produces that reaction. These weapons would temporarily incapacitate an individual or group without lasting physiological damage.²⁰

At Idaho National Laboratory the NIJ funded research in to airbag restraint systems for police vehicles.²¹

Other NIJ funded research projects initiated in 1992 and 1993 were studies by the American Correctional Association and the National Sheriffs' Association to assess the potential for use of "non-lethal" weapons in prisons as well as in riot control and individual confrontations with police. The Police Foundation was contracted to analyse past scenarios where "non-lethal" weapons may have been useful and the Institute for Law and Justice began research on public attitudes to "non-lethal" weapons.²²

In addition to technological co-operation with the Department of Energy, the National Institute of Justice also sought to review military technologies that could be applied to their Less-than-Lethal Technology Program. In early 1993 the NIJ funded a panel convened by Vice Admiral Burkhalter Jr. and

comprising senior policy experts including William Webster, former head of the FBI and the CIA.²³ An early recommendation of the panel was that the Attorney General Janet Reno should request an agreement with the Defense and Intelligence communities on technology development.²⁴ In June 1993 Reno wrote to the Department of Defense (DOD) and the Central Intelligence Agency (CIA) to suggest collaborative efforts to develop dual-use technologies for law enforcement and the military.²⁵ This led to a Memorandum of Understanding between the Department of Defense and the Department of Justice for sharing of technology and systems to enhance operations other than war (OOTW) and law enforcement, signed on 20 April 1994.²⁶ The programme was overseen by a Joint Program Steering Group at the DOD's Defense Advanced Research Projects Agency (DARPA)²⁷ with members from DARPA, NIJ, the FBI, the Bureau of Prisons, and the US Army. The programme of work got underway in March 1995 with \$26 million to fund projects in seven technology areas, one of which was "non-lethal" weapons.²⁸

From the point of view of the Department of Justice a number of events had added urgency to their "non-lethal" weapons development efforts in the early 1990's.²⁹ In March 1991 Rodney King was apprehended and brutally beaten by Los Angeles police officers with batons. Two cartridges from a Taser electrical weapon were also fired at him during the incident.³⁰ For police, the ineffectiveness of the Taser in subduing him had indicated the requirement for further "non-lethal" weapons development to prevent excessive use of force.³¹ However, others have pointed to the incident as an example of how "non-lethal" weapons may be used by police to supplement more dangerous weapons rather than to replace them.³² The acquittal of the four police officers who carried out the beating in April 1992 led to the Los Angeles riots, which left over 50 people dead and over 2000 injured.³³ National Guard troops drafted in to control the situation did not have access to "non-lethal" weapons³⁴ and these events bolstered research and development efforts.³⁵ In addition, the siege of a family at Ruby Ridge, Idaho in August 1992, where snipers operated a "shoot-on-sight" policy, led to a review of the Federal Bureau of Investigation's (FBI) rules for the use of lethal force.³⁶

Perhaps the most significant incident, however, was the siege of the Branch Davidian compound at Waco by the Bureau of Alcohol Tobacco and Firearms (ATF) and the FBI from 28 February to 19 April 1993, which left 76 people inside dead including more than 20 children.³⁷ The Attorney General, Janet Reno, had approved an FBI plan to use the irritant chemical agent CS to end the siege.³⁸ Armoured vehicles made holes in the walls through which CS was pumped into the building and additional barricade penetrating CS cartridges, called ferret rounds, were fired through the doors and windows.³⁹ The FBI also fired several military CS grenades.⁴⁰ Six hours into the operation fires started in the building and there were just nine survivors.⁴¹ Before the operation to break the siege the FBI had sought other techniques to try get those inside to leave the compound including shining bright lights during the night and playing recordings of unpleasant sounds and music.⁴² Furthermore there were reports that they had flown in a Russian scientist who had been developing techniques to alter behaviour using subliminal messages. The idea was to deliver these messages during phone

conversations between the negotiators and those inside but the plan fell through.⁴³

It was in the immediate aftermath of the Waco disaster that Janet Reno set in motion the collaboration on law enforcement technologies (including “non-lethal” weapons) with the Department of Defense. The events at Waco were cited at the time as a reason for accelerating the National Institute of Justice’s efforts on “non-lethal” weapons technology⁴⁴ and even now the incident is used as an exemplar scenario to encourage further technological development that might provide a solution to similar incidents in the future.⁴⁵ Rappert later observed that failures in such interventions, even when they involve the use of existing “non-lethal” weapons, are often used to bolster the case for developing new weapons technology rather than to question its’ use in the first place. He argues that such a technological focus may be to the detriment of other priorities such as training or conflict management techniques.⁴⁶ According to one DOJ-sponsored history of research at the National Institute of Justice, published in 1994, another factor that contributed to the perceived need to develop new “non-lethal” weapons in the early 1990’s was the public concern over the safety of the irritant agent⁴⁷ oleoresin capsicum (OC) or pepper spray. This threatened to restrict police use of such sprays, which were being used very widely at time.⁴⁸

The NIJ’s collaboration with the Department of Energy and the Department of Defense on “non-lethal” weapons development was part of a broader approach in the 1990’s to exploit the expertise of existing government and private sector research and development infrastructure.⁴⁹ In 1994 the NIJ carried out a reorganisation specifically to assist in developing or adapting new technologies for law enforcement. The Division of Science and Technology was upgraded to the Office of Science and Technology (OST) and an advisory council, the Law Enforcement and Corrections Technology Advisory Council (LECTAC) was established to provide advice to a new system of National Law Enforcement and Corrections Technology Centers (NLECTC) tasked with testing and evaluating new technologies.⁵⁰ Furthermore, in 1995 the NIJ established an Office of Law Enforcement Technology Commercialization (OLETC) to assist in the commercialization of new technologies for law enforcement. The OLETC is a joint project sponsored by the NIJ, the National Aeronautics and Space Administration (NASA) and the National Technology Transfer Center (NTTC). The LECTAC panel was to set the research agenda for NIJ’s Office of Science and Technology and amongst its’ top priorities in the 1990’s was the development of “non-lethal” weapons.⁵¹

Specific recommendations on the direction of “non-lethal” weapons research and development were made by the Less-than-Lethal (LTL) Technology and Policy Assessment Executive Panel and the Less than Lethal Liability Task Group. The former is described in a 1998 NIJ history of police technology:

The LTL panel is made up of state and local law enforcement, elected officials, and current as well as former high-ranking federal government officials. It reviews technology needs, developments, and innovations from a national perspective and makes regular recommendations to NIJ. The panel also advises the law enforcement

community on ways of developing government and national support in fulfilling an aggressive technology agenda while ensuring that law enforcement needs are being fulfilled.⁵²

The formation of the related Liability Task Group reflected the potential impact of lawsuits on technology development and during the 1990's this it addressed these issues in relation to a number of different "non-lethal" weapons:

The Liability Task Group assesses civil liability issues associated with technologies in various stages of research, development, and use. The task group has examined the liability aspects of such technologies as pepper spray, chemical darts, sticky foam, aqueous foam, smart guns, projectable nets, disabling strobe lights, projectable bean bags, microwave devices to disable automobiles, weapons detection devices, thermal imaging and forward-looking infrared devices (FLIR), and rear seat airbag restraints.⁵³

The work of the panel and associated task group was funded through a series of grants from the NIJ with funds awarded every year from 1994 to 2000.⁵⁴

The topics and associated contractors of all NIJ grants awarded from 1994 to 1999 for work related to anti-personnel "non-lethal" weapons are shown in Table 1 below. These contracts provide an overview of the NIJ's priorities with regard to "non-lethal" weapons development during the 1990's. However, this list of contracts only relates to NIJ funding and excludes co-operative projects funded from other sources such as the DOJ-DOD Joint Program Steering Group. The funding was relatively modest during this period averaging at around \$1.5 million per year.⁵⁵ As regards specific technologies much of the focus was on assessing existing weapons such as oleoresin capsicum (OC) spray, electrical stun devices, and kinetic energy projectiles. However, NIJ also funded two projects to develop restraining nets, a project to modify the US Army developed Ring Airfoil Projectile (RAP)⁵⁶ as well as US Air Force studies of a "dazzling" laser weapon and the potential use of low-frequency sound as an acoustic weapon. There were several projects assessing the human effects of various weapons including a prototype electrical projectile, the "sticky shocker", which was developed through the collaborative programme with the Department of Defense.⁵⁷ Whilst this research sought to overcome the range limitations of existing electrical weapons, one of the most significant developments during the 1990's was the advance of the Taser design in the commercial sector where new higher-power Taser models were developed in the late 1990's and first introduced in 1999.

Table 1: National Institute of Justice contracts relating to anti-personnel “non-lethal” weapons, 1994-1999.⁵⁸

Initial Funding	Additional Funding	Description	Contractor
(1992)	1994	Application/Evaluation of Less-Than-Lethal Weapons in Jails and Patrol Situations	National Sheriffs' Association
(1992)	1994	Field Evaluation of Less-Than-Lethal Weapons in a Prison Setting, Phase Two	American Correctional Association
(1992)	1994	Less-Than-Lethal Weapons Program – Technical Support ⁵⁹	Office of Intelligence, Department of Energy
(1993)	1994	Less-Than-Lethal Weapons Technology and Policy Assessment ⁶⁰	Burkhalter Associates, Inc.
(1993)	1998, 1999	Public Acceptance of Police Technologies ⁶¹	Institute for Law and Justice, Inc.
1994	-	Airbag Restraint System for Patrol Vehicles	Idaho National Engineering Laboratory
1994	-	Aqueous Foam System ⁶²	Sandia National Laboratory
1994	-	Evaluation of Oleoresin Capsicum and Stun Device Effectiveness	National Sheriffs' Association
1994	-	Less-Than-Lethal Weapons Technology and Policy Liability – Technical Assistance ⁶³	Burkhalter Associates, Inc.
1995	-	Less-Than-Lethal Technology Assessment and Transfer ⁶⁴	Booz Allen Hamilton, Inc.
1995	-	Net Deployment Module for a Snare Net Projectile	Foster-Miller, Inc.
1995	1996	Law Enforcement Technology, Technology Transfer, Less-Than-Lethal Technology, and Policy Assessment ⁶⁵	SEASKATE, Inc.
1995	1996	Law Enforcement Technology, Technology Transfer, Less-Than-Lethal Weapons Technology, and Policy Liability Assessment ⁶⁶	SEASKATE, Inc.
1996	1997, 1998, 1999, (2000)	Less-Than-Lethal Technology Policy Assessment Panel ⁶⁷	SEASKATE, Inc.
1996	1998, 1999, (2000)	Law Enforcement Technology, Technology Transfer, Less-Than-Lethal Weapons Technology, and Policy Liability Assessment	SEASKATE, Inc.
1997	-	Armstrong Laboratory Acoustic Study ⁶⁸	Armstrong Laboratory, US Air Force
1997	-	Development of a Baton With a Projectable Restraining Net	LRF, Inc.
1997	-	Evaluation of Oleoresin Capsicum	University of North Carolina–Chapel Hill
1997	1998, 1999, (2000, 2001)	Ring Airfoil Projectile System ⁶⁹	Guilford Engineering Associates, Inc.
1997	-	Pepper Spray Projectile Disperser	Delta Defense, Inc.
1997	-	Health Hazard Assessment for Kinetic Energy Impact Weapons	US Army
1998	1999, (2000)	Biomechanical Assessment of Nonlethal Weapons ⁷⁰	Wayne State University
1998	-	Development of a Database of the Effects of Less-Than-Lethal Weapons	Pro Tac International
1998	-	Evaluation of the Human Effects of a Prototype Electric Stun Projectile ⁷¹	Pennsylvania State University
1998	-	Laser Dazzler Assessment ⁷²	US Air Force Research Laboratory
1998	-	Impact of Oleoresin Capsicum Spray on Respiratory Function in the Sitting and Prone Maximal Restraint Positions	University of California, San Diego
1999	-	Applicability of Nonlethal Weapons Technology in Schools ⁷³	DynMeridian Corporation
1999	-	Preliminary Characterization and Safety Evaluation of Defense Technology's OC Powder ⁷⁴	Chemical Delivery Systems, Inc.

Research on “non-lethal” weapons received significant attention in the National Institute of Justice’s annual reports to the US Congress during the late 1990’s. In its’ 1998 annual report the NIJ set out the major aspects of the Less-than-Lethal (LTL) Technology Program:

- Funding the development and improvement of existing LTL technologies.
- Testing and evaluating the safety and effectiveness of LTL technologies.
- Addressing the legal liabilities and social acceptability issues raised by LTL technologies.
- Coordinating with other Federal and international agencies to leverage LTL research, testing, and technology development.
- Providing information to law enforcement and corrections agencies about LTL technologies.⁷⁵

In addition to collaborative efforts with other US Government agencies, the National Institute of Justice initiated co-operative agreements on science and technology development with other countries in the late 1990’s that included the subject of “non-lethal” weapons. A formal Memorandum of Understanding (MOU) was signed with the UK Home Office Police Scientific Development Branch (PSDB)⁷⁶ in February 1997 as “...a framework for cooperation and collaboration in research, development, evaluation and operational use of law enforcement technologies.”⁷⁷ PSDB would soon draw heavily on the research of the National Institute of Justice in its search for an alternative “non-lethal” weapon to replace the plastic bullet.⁷⁸ In 1999 NIJ signed a similar MOU with the Israeli Ministry of Public Security.⁷⁹ NIJ also conducted collaborative research with the Canadian Police Research Centre (CPRC) including work on “non-lethal” weapons technologies. The UK’s Police Scientific Development Branch (PSDB) itself signed an MOU with the Canadian Police Research Centre (CPRC) for research cooperation in 1998.⁸⁰ These UK, Canadian and Israeli organisations were all represented on the National Institute of Justice’s Law Enforcement and Corrections Technology Advisory Council (LECTAC).⁸¹

In the UK there was little research and development ongoing with regard to new “non-lethal” weapons during the 1990’s apart from further development of the plastic baton round (PBR) or plastic bullet. Incremental modifications of the plastic bullets had occurred since their original introduction in the early 1970’s. A new, more accurate, launcher was introduced in 1994 and a research project to develop a new projectile was initiated in 1997. In 1996, during widespread rioting in Northern Ireland, over 8,000 rounds were fired. Subsequently a Government commission reviewed their use in Northern Ireland and more restrictive guidelines were introduced in 1999. From 1996 onwards the number of rounds fired was greatly reduced.⁸² The 1999 Report of the Independent Commission on Policing for Northern Ireland noted the lack of research and development into new “non-lethal” weapons:

In view of the fatalities and serious injuries resulting from PBRs, and the controversy caused by their extensive use, we are surprised and concerned that the government, the Police Authority and the RUC have collectively failed to invest more time and money in a search for an acceptable alternative. We were able to discover very little research work being done in the United Kingdom (except in the development of more accurate PBRs). By contrast, we were impressed by the efforts being made and the commitment to develop non-lethal weaponry alternatives in the United States,

particularly at the Institute for Non-Lethal Defense Technologies at Pennsylvania State University and the National Institute of Justice in Washington.⁸³

Amongst the recommendations of the Commission were two (numbers 69 and 70) that would guide UK research and development of “non-lethal” weapons in the following years:

69 We recommend that an immediate and substantial investment be made in a research programme to find an acceptable, effective and less potentially lethal alternative to the PBR.

70 We also recommend that the police be equipped with a broader range of public order equipment than the RUC currently possess, so that a commander has a number of options at his or her disposal which might reduce reliance on, or defer resort to, the PBR.⁸⁴

In the UK the major development in terms of deployment of new “non-lethal” weaponry during the 1990’s was the introduction of CS sprays. A six-month operational trial was conducted amongst 16 police forces and in August 1996 the government approved their use by all police forces in England and Wales.⁸⁵

3. Military Developments

It was not until the early 1990’s that military interest in “non-lethal” weapons began to develop in earnest. This was made possible, as Lewer and Schofield point out, by the changing international security environment:

Only with the end of the Cold War and the re-evaluation of security issues was the potential of non-lethal weapons considered seriously. Compared to the 1970s, general technological advances had enhanced the prospects of developing fieldable equipment in terms of size, accuracy, speed of deployment etcetera. But, in themselves, technological advances would have been insufficient to secure funding without some strategic rationale that could attract support from influential organizations and individuals including government policy makers and the armed forces.⁸⁶

This strategic rationale was that “non-lethal” weapons were needed in response to the predicted rise in low-intensity conflict and interventions by ‘Western’ countries in regional conflicts particularly in relation to operations-other-than-war (OOTW) such as peacekeeping and peace enforcement, where conventional military weapons and tactics, it was argued, would not be effective. In the US interest was aroused through lobbying by the US Global Strategy Council in Washington DC, a conservative think-tank then headed by the former Deputy Director of the CIA, Ray Cline.⁸⁷ Researchers at the Global Strategy Council, Janet and Chris Morris, authored a series of papers in the early 1990’s setting out their vision of “nonlethality” as a “revolutionary strategic doctrine” including *Nonlethality: A Global Strategy White Paper*.

Nonlethality will allow the U.S. to lead the world toward a new global order, away from war-fighting and toward peacekeeping, while enhancing our diplomatic efforts and our ability to project American power, when necessary worldwide.

Nonlethality augments our powerful high-technology deterrence capability by adding a new level of narrowly constrained use of force. Nonlethality means responding to conflict with the minimum force effective. Regional and low intensity conflict (adventurism, insurgency, ethnic violence, terrorism, narco-trafficking, domestic crime) can only be countered decisively with low lethality operations, tactics, and weapons.⁸⁸

Initial lobbying by the Global Strategy Council had resulted in the formation of a Nonlethal Strategy Group at the US Department of Defense, established by then Secretary of Defense Dick Cheney in March 1991 at the recommendation of then Undersecretary of Defense for Policy Paul Wolfowitz, who would head the group. The Memorandum detailing this recommendation made the case for accelerated research:

A US lead in nonlethal technologies will increase our options and reinforce our position in the post-cold war world. Our R&D efforts must be increased in part to develop countermeasures for our own protection.⁸⁹

The group subscribed to the Morris's view that "non-lethal" weapons offered revolutionary potential and that a non-lethal defence initiative similar to the Strategic Defense Initiative (SDI) should be established.⁹⁰ This fitted into broader discussions in the aftermath of the 1991 Gulf War about rapid advances in military technology, described as a Military Technical Revolution (MTR), itself characterised as part of a shift in military doctrine and operations portrayed as a Revolution in Military Affairs (RMA).⁹¹ An early 1990's study on the Military Technical Revolution (MTR) by the Center for Strategic and International Studies (CSIS) speculated on the revolutionary potential of "non-lethal" weapons:

If U.S. forces were able, through electronic, electromagnetic, directed energy, or other means to incapacitate or render ineffective enemy forces without destroying or killing them, the U.S. conduct of war would be revolutionized. The whole calculus of costs, benefits, and risks would change for both the United States and its potential adversaries.⁹²

Ultimately the Department of Defense working group met resistance to their proposed initiative due to disagreements within the Pentagon and it was not until the Clinton administration came to power in 1992 that there were renewed efforts to put "non-lethal" weapons back on the agenda as the new Secretary of Defense, Les Aspin, conducted a review of defense priorities.⁹³ John Alexander, Program Manager for 'Non-Lethal Defense' within the Special Technologies Group at Los Alamos National Laboratory (LANL), who had been working on "non-lethal" weapons at Los Alamos since the late 1980's, presented a paper in 1992 to Clinton's transition team advocating the establishment of a "...cohesive plan to study these capabilities and develop the supporting doctrine."⁹⁴ Like Janet and Chris Morris he presented his ideas in terms of revolutionary solutions to new security priorities. Consistent with his *Military Review* article from 1989⁹⁵ the focus of attention was anti-materiel rather than anti-personnel weapons technologies:

Non-Lethal Defence concepts propose employment of weapons other than smart hard bombs but that can achieve the same basic results in systems degradation: strategic paralysis of the adversary.⁹⁶

In the early 1990's it was the national laboratories, such as Los Alamos, that were setting the tone of "non-lethal" weapons technology development. As a 1995 Council on Foreign Relations report later observed:

In the absence of any national policy on non-lethal weapons, development of non-lethal technologies has been largely driven by various scientific laboratories offering proposals as their nuclear warfare budgets were reduced.⁹⁷

In addition to cuts in defence budgets the Clinton administration had emphasised the need for the laboratories to focus on research with dual civil-military applications. Since the national laboratories already had expertise in relevant areas such as lasers and acoustics, "non-lethal" weapons fitted into this framework and programmes were expanded.⁹⁸

The major research and development efforts at this time comprised collaborative projects between the US Army's Armament Research, Development and Engineering Center (ARDEC) and Los Alamos and Lawrence Livermore National Laboratories.⁹⁹ From 1991 to 1995 ARDEC operated a Low Collateral Damage Munitions (LCDM) programme at Picatinny Arsenal in New Jersey.¹⁰⁰ This effort sought to develop weapons that could "...effectively disable, dazzle or incapacitate aircraft, missiles, armoured vehicles, personnel and other equipment whilst minimizing collateral damage."¹⁰¹ Reflecting the approach at Los Alamos, the initial focus was on anti-materiel concepts based on unconventional technologies. ARDEC proposed that such weapons would not only offer benefits in terms of reducing "collateral damage" but also performance benefits over conventional weaponry. The stated purpose was to develop weapons with variable effects, from to "non-lethal" to lethal.¹⁰² The Army was also taking the first steps at developing operational doctrine during this period, circulating a draft *Operations Concept for Disabling Measures* in 1992,¹⁰³ which later led to the publication by the Army Training and Doctrine Command (TRADOC) of the *Concept for Nonlethal Capabilities in Army Operations* in 1996.¹⁰⁴

Projects in the ARDEC LCDM programme intended for anti-personnel application included: research with Los Alamos National Laboratory (LANL) on pulsed chemical lasers that would create a high pressure plasma and resultant blast wave, intended for use against people and materiel; contracted research and development by Scientific Applications & Research Associates (SARA) Inc. on two acoustic weapon concepts, one employing a low frequency acoustic beam and the other termed an acoustic bullet; and a joint research effort with the US Army Edgewood Research Development and Engineering Center (ERDEC) on incapacitating chemicals as part of the advanced riot control agent device (ARCAD) programme. In addition, researchers in the Armstrong Laboratory at the Brooks Air Force base had been tasked with assessing the bioeffects of laser weapons.¹⁰⁵ In their 1997 book Lewer and Schofield summarised the roles of the different research organisations that were involved in this development programme:

In simple terms, ARDEC is concentrating on the development of delivery systems and munitions while the laboratories provide important support through their expertise in the basic sciences and applied physics.¹⁰⁶

Together with ARDEC and the national laboratories, the other main actor was the Defense Advanced Research Projects Agency (DARPA). The ARDEC programme itself had grown out of earlier work done by DARPA¹⁰⁷ and in 1994 the agency had been tasked with co-ordinating the joint Department of Justice – Department of Defense effort on dual-use technologies including “non-lethal” weapons. Within this joint initiative calls for proposals on “non-lethal” weapons or “limited effects technology”, as it was termed by DARPA, were put out in May 1995 seeking technologies for stopping a fleeing individual, controlling hostile crowds, and stopping moving vehicles.¹⁰⁸ Amongst those anti-personnel areas funded were research projects on: high-intensity low frequency acoustics at the US Air Force Armstrong Laboratory; man-portable and vehicle mounted “dazzling” laser weapons at the US Air Force Phillips Laboratory; a launched wireless electric shock projectile, the “Sticky Shocker”, with Jaycor Company; and smoke grenades at the Army’s Edgewood Research Development and Engineering Center (ERDEC).¹⁰⁹ By the time of a January 1997 review of the initiative, progress on actual weapons systems amounted to the demonstration of a vehicle-mounted “dazzling” laser system in June 1996 and the demonstration of a prototype “Sticky Shocker” projectile in August 1996. Research was ongoing on flash-bang and smoke grenades at ERDEC and on using acoustic energy for crowd control at the Air Force Armstrong Laboratory.¹¹⁰

From a military perspective the technology requirements and the overlap with law enforcement priorities had been noted by a working group convened by DARPA in 1993 to help formulate a research and development programme to “enhance the effectiveness” of US forces involved in operations-other-than-war (OOTW). This had been triggered by events in Somalia and elsewhere.¹¹¹ The number of UN peacekeeping operations had increased dramatically in the early 1990’s including operations in the Former Yugoslavia, Somalia and Haiti.¹¹² And in 1993 the US Marines had been sent to Somalia to assist the UN peacekeeping mission in a humanitarian operation to distribute food. In terms of “non-lethal” weapons the Marines had batons and OC spray but they had little effect in controlling crowds and, with escalating violence, they relied on lethal force and many civilians were killed.¹¹³

In late 1994 the US Marines were tasked with assisting in the withdrawal of UN peacekeepers from Somalia in what would be Operation United Shield. Due to the nature of the operation the Marines investigated what weapons they could acquire for use in crowd control. With assistance from the Army¹¹⁴ they acquired: five types of 40mm grenade-launched kinetic energy projectiles, three types of 12 gauge shotgun projectiles, various OC spray devices, stinger grenades, flash-bang grenades, sticky foam, and aqueous foam.¹¹⁵ The foam devices were supplied by Sandia National Laboratory, which had been developing the systems for the Department of Justice. Two different laser systems were also supplied to the Marines by the Air Force, who had been conducting research on these at the Phillips Laboratory. One was the Saber 203 Laser Illuminator, a red diode laser weapon intended to temporarily blind or “dazzle”. Another was a prototype solid-state green laser weapon.¹¹⁶ During the operation in March 1995 there was very little use of

these various weapons. Sticky foam was used to augment barriers, and it seems both laser systems were used on a limited basis to warn people off by illuminating them with the beam rather than being employed directly to affect vision due to concerns over damaging effects on the eye.¹¹⁷ Nevertheless the deployment of the weapons, and associated media coverage, was considered to have played an important role in deterring violence and in the successful completion of the withdrawal. The Marines' interest in "non-lethal" weapons was galvanized and the commander of the operation, Anthony Zinni, subsequently became an outspoken advocate. Some "non-lethal" weapons were also deployed with US troops during Operation Uphold Democracy in Haiti in 1994-95, namely OC pepper spray, plastic baton rounds, and beanbag rounds for shotguns. This deployment was also viewed favourably with John Sheehan, the former Commander in Chief of US Atlantic Command, also becoming a strong supporter of integrating "non-lethal" weapons in to the armoury.¹¹⁸

The early 1990's saw the first major military conferences on "non-lethal" weapons. The first, entitled 'Non Lethal Defense' and held in November 1993, was co-sponsored by Los Alamos National Laboratory (LANL) and the American Defense Preparedness Association and hosted by the Applied Physics Laboratory at Johns Hopkins University. The second conference in the series, 'Non Lethal Defense II' was held in March 1996 and the third, 'Non Lethal Defense III', in February 1998. The secrecy of ongoing "non-lethal" weapons development programmes was reflected in the requirement that participants for the first 'Non-Lethal Defense' conference had to be US citizens with Secret-level security clearances.¹¹⁹ There was disagreement over the issue of secrecy from the outset, as Lewer and Schofield noted in their 1997 book:

Some of the leading advocates such as the Morrisises argue that non-lethal weapons will achieve their greatest impact by means of an open assessment of capabilities and operational roles. Others, mainly from the traditional military establishments, argue that secrecy is of paramount importance to ensure maximum effectiveness.¹²⁰

The latter approach won out, with the argument that secrecy was necessary to avoid the development of countermeasures, and much work was being conducted within classified projects.¹²¹

The first attempts to organise the disparate military efforts on "non-lethal" weapons development in the US were made in February 1994 when a Non-Lethal Weapons Steering Committee (NLWSC) was established at the Department of Defense chaired by the Office of the Undersecretary for Defense for Acquisition and Technology and the Office of the Assistant Secretary of Defense for Special Operations and Low Intensity Conflict (OASD(SO/LIC)).¹²² In July 1994 the Steering Committee circulated a *Draft Policy for Non-Lethal Weapons* for review. It envisioned central oversight by the Committee over all "non-lethal" weapons development and acquisition activities.¹²³

A January 1995 report produced by influential think-tank the Council on Foreign Relations is viewed as having a significant impact on the subsequent

institutionalisation of “non-lethal” weapons in the US Department of Defense.¹²⁴ The report, entitled *Non-Lethal Technologies: Military Options and Implications*, considered the potential of “non-lethal” weapons for conflicts such as that in Somalia and the ongoing conflict in Bosnia and concluded that “...vigorous exploration of non-lethal technologies is politically, militarily, and morally appropriate, and affordable as well.”¹²⁵

In July 1996 US policy was formalised by Department of Defense (DOD) Directive 3000.3, *Policy for Non-Lethal Weapons*, which established the DOD’s Joint Non-Lethal Weapons Program (JNLWP). It defined “non-lethal” weapons as:

Weapons that are explicitly designed and primarily employed so as to incapacitate personnel or materiel, while minimizing fatalities, permanent injury to personnel, and undesired damage to property and the environment.¹²⁶

The purpose of the Directive was twofold: to establish policy and assign responsibility for the development and employment of “non-lethal” weapons and to designate the Marine Corps as the Executive Agent. The Marines would be “...responsible for program recommendations and for stimulating and coordinating non-lethal weapons requirements.”¹²⁷ There was to be no doubt as to the military’s view on the role for “non-lethal” weapons. They were not foreseen as ushering in a new era of humane warfare replacing conventional weaponry to some degree, as some analysts and commentators had speculated, but would be used to better achieve specified military objectives, as outlined in the Directive:

Discourage, delay, or prevent hostile actions;
Limit escalation;
Take military action in situations where use of lethal force is not the preferred option;
Better protect our forces;
Temporarily disable equipment facilities, and personnel.”¹²⁸

Moreover their use together with conventional “lethal” weapons, in a pre-lethal manner to make killing easier, was officially endorsed:

Non-lethal weapons may be used in conjunction with lethal weapon systems to enhance the latter's effectiveness and efficiency in military operations. This shall apply across the range of military operations to include those situations where overwhelming force is employed.¹²⁹

Coates’s advice in 1970 that “non-lethal” and “lethal” tactics should be kept separate was long forgotten.¹³⁰

In January 1997 the JNLWP became operational with the signing of a Joint Service Memorandum of Agreement that established the organisational structure of the program. The Joint Non-Lethal Weapons Directorate (JNLWD), run by the Marines, would be the focal point for co-ordination of all “non-lethal” weapons development activities, guided by a Joint Non-Lethal Weapons Integrated Product Team (JIPT) and a Joint Coordination and Integration Group (JCIG).¹³¹ Shortly after the JNLWD was established it conducted a review of existing “non-lethal” weapons programmes in the

Department of Defense.¹³² Anti-personnel non-lethal weapons selected for further development following this review are shown in Table 2 below. The programmes are presented in the order they were prioritised by the JNLWD.

Table 2: Review and prioritisation of anti-personnel “non-lethal” weapons programmes by the Joint Non-Lethal Weapons Directorate.¹³³

Weapon	Details	Developer ¹
40-mm non-lethal crowd dispersal cartridge	M203 grenade launched munition with range of 10-50 metres and payload of rubber ‘sting’ balls.	ARDEC, US Army
Acoustic bioeffects and acoustic generators	Use of extremely low frequency sound (infrasound) as an acoustic weapon. <i>(Programme ended in 1999 due to lack of demonstrated effects)</i>	ARDEC, US Army & SARA Inc.
Modular Crowd Control Munition (MCCM)	Variant of the Claymore mine delivering a payload of rubber ‘sting’ balls.	ARDEC, US Army
Vehicle-Mounted Active Denial System (VMADS)	Prototype directed energy millimetre wave weapon mounted on a HMMWV armoured vehicle, initially developed for physical security applications. <i>(Programme classified at the time)</i>	AFRL, US Air Force
66-mm vehicle-launched grenade	Grenade launched from Light Vehicle Obscuration Smoke System (LVOSS) with a range of 50-100 metres and two different payloads: rubber ‘sting’ balls or flash-bang.	ARDEC, US Army
Unmanned aerial vehicle (UAV) non-lethal payload program	Dispenser developed for UAV’s such as the Dragon Drone to deliver various payloads including: riot control agents, malodorants, electronic noise/siren, rubber ‘sting’ balls and marker dye.	NSWCDD, US Navy & MCWL, US Marines
Bounding Non-Lethal Munition (BNLM)	Variant of the M16A2 anti-personnel mine with various different payloads proposed: rubber ‘sting’ balls, electric-shock net, malodorants, riot control agents, and marker dye. <i>(Programme ended post 2002)</i>	ARDEC, US Army
Canister Launched Area Denial System (CLADS)	Adaptation of Volcano Mine Dispenser System, mounted on HMMWV armoured vehicle to rapidly deliver 20 mines containing rubber ‘sting’ balls. <i>(Programme ended post 2002)</i>	ARDEC, US Army
Foam systems	Non-lethal slippery foam to deny access to people and vehicles. (Also rigid foam but for anti-materiel applications only)	ECBC, US Army & SwRI
Vortex ring gun	Investigation into the adaptation of the Mk19-3 grenade launcher to deliver payloads such as riot control agents, malodorants or smokes via gas vortices. <i>(Programme ended in 1998 due to unpredictable effects and limited range)</i>	ARL & ARDEC, US Army
Under-barrel tactical payload delivery system	Devices for delivery of various payloads, mounted under M16A2 and M4 rifles. <i>(Programme ended post 2002)</i>	ARDEC, US Army

The majority of existing programmes available for consideration by the JNLWD in their review were ongoing as part of the US Army’s Low Collateral

¹ Acronyms as follows: Army Research, Development and Engineering Center (ARDEC); Scientific Applications & Research Associates (SARA Inc.); Air Force Research Laboratory (AFRL); Naval Surface Warfare Center, Dahlgren Division (NSWCDD); Marine Corps Warfighting Laboratory (MCWL); Edgewood Chemical and Biological Center (ECBC); and Southwest Research Institute (SwRI)

Damage Munitions (LCDM) programme at the Army Research, Development and Engineering Center (ARDEC). At the time JNLWD's remit did not cover many of the Air Force and Navy "non-lethal" weapons research efforts.¹³⁴ The majority of the programmes considered in the review, as shown in Table 2 above, involved the development of new delivery systems primarily employing low-tech "non-lethal" payloads such as rubber balls, and riot control agents (RCAs). Initially considerable priority was also given to the Army led programme on acoustic weapons in collaboration with SARA Inc., the Air Force Armstrong Laboratory, and the Air Force Research Laboratory (AFRL).¹³⁵ However, this Non-Lethal Acoustic Weapons (NLAW) programme was closed down in 1999.¹³⁶ Another programme employing new technology that had attracted considerable interest was the Air Force Research Laboratory's (AFRL) development of so called Active Denial Technology employing millimetre wave electromagnetic radiation to heat the skin and cause pain. The prototype system integrated the technology onto a HMMWV armoured vehicle and was termed the Vehicle Mounted Active Denial System (VMADS).¹³⁷ The system was classified project at the time and it was not declassified until December 2000.¹³⁸ The review did not consider ongoing Air Force and DARPA research on "dazzling" laser weapons.¹³⁹ However, there was certainly significant interest in these devices from the Marines. Several wargaming exercises were conducted in the late 1990's that focused on such lasers as well as conceptual directed energy weapons. The Emerald Express exercise in May 1999 specifically addressed the use of "dazzling" lasers and surrounding policy issues.¹⁴⁰

Army research and development of incapacitating chemicals at Edgewood Research Development and Engineering Center (ERDEC) and associated delivery systems at ARDEC, as part of the advanced riot control agent device (ARCAD) programme, apparently was not included in the JNLWD's review. Ostensibly the programme had been halted due to the negotiation of the Chemical Weapons Convention (CWC), which was opened for signature in January 1993.¹⁴¹ However, although full development of the ARCAD weapon was curtailed, research and development to find new incapacitating chemical agents continued.¹⁴² In any case the Department of Justice continued to sponsor research on incapacitating chemicals and their delivery systems at Lawrence Livermore National Laboratory (LLNL) building on previous ERDEC work. And soon the JNLWD itself would revisit the Army's research.

The JNLWD quickly sought ideas for new "non-lethal" weapons technologies and in 1997 instigated a Technology Investment Program (TIP) to fund 1-2 year research initiatives in 'state-of-the-art' technologies within government laboratories, industry, and academia. Following an announcement soliciting ideas in May 1997 the JNLWD received 63 proposals. Of the three selected for funding in fiscal year 1998, two were anti-personnel related. The first was a study of malodorant chemicals at the Army's Edgewood Research, Development, and Engineering Center (ERDEC).ⁱⁱ The second funded project was on the development of spider fibre as an entangling material for use against vehicles or people.¹⁴³ This work was carried out by the Naval Surface

ⁱⁱ ERDEC changed its name in 1998, becoming Edgewood Chemical and Biological Center (ECBC).

Warfare Center, Dahlgren Division (NSWCDD) but the programme was closed in late 1998.¹⁴⁴

The selection of the spider fibre project reflected the JNLWD's rather ambitious approach to technology development. This is shown in the JNLWD's *Joint Concept for Non-Lethal Weapons*, published in 1998. It set out guiding principles to provide direction for the Joint Non-Lethal Weapons Program (JNLWP), emphasizing efforts to "leverage high technology":

The exploitation of advanced technologies with potential non-lethal weapons applicability calls for innovative, creative thinking. The Department of Defense non-lethal weapons approach must encourage the pursuit of nontraditional concepts. Our experimental and developmental approaches must be bound only by the limits of physical possibility. Otherwise, we impose artificial and unnecessary limits on our thinking and thus on the potential utility of non-lethal systems. Electronic, acoustic, and nanotechnological approaches, among others, may offer high-payoff avenues of investigation and application.¹⁴⁵

In fiscal year 1998 just over \$16 million was spent on the "non-lethal" weapons programme. This was the first year of separate funding for the programme and consisted of funds redirected from other Army and Navy programmes.¹⁴⁶ The majority of this money was spent on further development of the weapons programmes prioritised by the JNLWD in their initial review (shown in Table 2) and just under \$730,000 was spent on the three projects selected through the Technology Investment Program (TIP).¹⁴⁷ This figure for total funding of "non-lethal" weapons is misleading because it only refers to funds for allocation by the Joint Non-Lethal Weapons Directorate (JNLWD). From the outset additional funding for certain "non-lethal" weapons systems and projects came from other armed services. For example in fiscal year 1998, in addition to the \$1.9 million spent on the millimetre wave Active Denial Technology (ADT) by the JNLWD,¹⁴⁸ the Air Force also spent \$431,000¹⁴⁹ on the system. Furthermore in the same year the Air Force spent \$4.7 million on research into the bioeffects of radiofrequency radiation from both lethal and "non-lethal" directed energy weapons, some of which will have been relevant to the Active Denial Technology (ADT).¹⁵⁰ Other "non-lethal" weapons projects were funded entirely separately. For example, in fiscal year 1998 the Air Force spent \$1.1 million on the further development of the Saber 203 Laser Illuminator, a "dazzling" laser weapon.¹⁵¹

In May 1998 the JNLWD released a so called "Broad Area Announcement for Non-Lethal Technologies" seeking new ideas as part of its' ongoing Technology Investment Program (TIP). The announcement required that proposals address one or more of the JNLWD's requirements which were for: 1) A rheostatic weapon system ("A single weapon whose effects are tunable across the entire force spectrum (from no effect up to lethal effect) is desired"); 2) Technology to employ non-lethal weapons at greater range (beyond 100 metres); 3) Various operational capabilities – a) incapacitate personnel, b) seize personnel, c) denial of area to vehicles, d) clear facilities of personnel, e) denial of area to personnel, f) disable/neutralize vehicles, aircraft, vessels, and facilities; and 4) Non-lethal alternatives to anti-personnel landmines.¹⁵²

From 83 proposals submitted eight were selected for funding under the Technology Investment Program (TIP) for fiscal year 1999, as shown in Table 3 below:

Table 3: Proposals selected for funding through the Joint Non-Lethal Weapons Directorate's Technology Investment Program in fiscal year 1999.¹⁵³

Weapon	Details	Developer(s) ⁱⁱⁱ
Pulsed Energy Projectile (PEP)	Development of a pulsed high energy chemical laser to produce a high temperature plasma at the target surface with variable effects from "non-lethal" to lethal. The name Pulsed Energy Projectile did not emerge until a later date.	Mission Research Corp.
81 mm mortar	Development of an 81mm mortar round to deliver "non-lethal" payloads ranges of up to 1.5 km.	United Defense Inc., ARL and ECBC, US Army.
Overhead Chemical Agent Dispersion System (OCADS)	Development of a dispersal system to be used with various munitions to deliver chemical agents over a wide area. It was later termed the Overhead Liquid Dispersal System (OLDS).	Primex Aerospace Co.
Frangible mortar	Investigation of material for a proposed frangible (later combustible) 120 mm mortar round.	ARDEC, US Army.
Extended Range Guided Munition (ERGM)	Feasibility study of using an existing munition to deliver "non-lethal" payloads over long ranges.	Raytheon Corp.
Advanced Tactical Laser (ATL)	Feasibility study of an airborne high energy chemical laser for "non-lethal" and lethal applications. This was presented as "non-lethal" by virtue of its' intended targets being materiel. The proposed weapon would be lethal if used against personnel.	Boeing Co.
Microencapsulation of chemical agents.	Investigation of the use of microcapsules for delivering chemical agents.	APL, University of New Hampshire
Taser anti-personnel mine	Development of a Taser-based electrical anti-personnel mine.	Primex Aerospace Co. and Tasertron Co.

The JNLWD also initiated partnerships with academic departments in the late 1990's in order to institutionalise "non-lethal" weapons research and development.¹⁵⁴ In November 1997 the Applied Research Laboratory at Penn State University established the Institute for Non-Lethal Defense Technologies (INLDT) to conduct interdisciplinary research in support of DOD and DOJ "non-lethal" weapons development programmes by carrying out technical, human effects and policy assessments of various technologies. From the outset the institute was supported both politically and financially by the Marine Corps, and more specifically the JNLWD. The Marines signed a Cooperative Research and Development Agreement with the Institute in 1997 and initial work funded by the JNLWD was the establishment of a Human Effects Advisory Panel (HEAP) to assess data on "non-lethal" weapons

ⁱⁱⁱ Acronyms as follows: Army Research Laboratory (ARL); Army Research, Development and Engineering Center (ARDEC); Edgewood Chemical and Biological Center (ECBC); Advanced Polymer Laboratory (APL), University of New Hampshire.

effects.¹⁵⁵ Subsequently, in June 1999, the Marines signed an agreement with Penn State University establishing it as the Marine Corps Research University (MCRU) to fulfil military research contracts covering a variety of topics including “non-lethal” weapons, thus further strengthening the links between the organisations.¹⁵⁶

Also in 1999 the JNLWD extended their efforts to investigate new technologies for “non-lethal” weapons when they provided a grant to the University of New Hampshire to establish the Non-Lethal Technology Innovation Center (NTIC) with a mission “...to effect the next generation of nonlethal capabilities by identifying and promoting the development of innovative concepts, materials, and technologies.”¹⁵⁷ The JNLWD funds NTIC’s activities, which are primarily the awarding of grants for research on “non-lethal” technologies as prioritised by the JNLWD. NTIC also holds an annual conference called the Non-Lethal Technology and Academic Research Symposium (NTAR) sponsored by the JNLWD, the first of which was held in May 1999.¹⁵⁸ As Feakin has argued, both the INLDT and the NTIC are essentially extensions of the JNLWD.¹⁵⁹

The 1990’s had seen increasing military support for “non-lethal” weapons and with the establishment of the Joint Non-Lethal Weapons Program (JNLWP) these weapons were beginning to be institutionalised within the US military. By the end of the decade the budget for the Joint Non-Lethal Weapons Directorate (JNLWD) had increased substantially from \$9.3 million in FY 1997 and \$16.1 million in FY 1998 to \$33.9 million in FY 1999.¹⁶⁰ Research and development was continuing on a number of existing programmes, originating from the individual military services (primarily the Army), and the JNLWD had begun a Technology Investment Program (TIP) to encourage development of new “non-lethal” weapons technologies. However, despite the increase in funding the JNLWP still only commanded a very small portion of the overall defence budget.

There appeared to be growing momentum on “non-lethal” weapons issues in 1999 with the publication of two studies by influential US think-tanks. The first was a “non-lethal” weapons policy study commissioned Office of the Secretary of Defense at the request of the National Security Council, funded by the JNLWD and authored by the Center for Strategic and International Studies (CSIS). It considered the strategic use of “non-lethal” weapons for large-scale long-range attacks in a variety of conflict scenarios, concluding that they had significant potential and that an expanded three-year research effort be undertaken by the JNLWD to assess the technical viability of various “non-lethal” weapons concepts with funding of \$100 million per year.¹⁶¹ In October 1999 the Council of Foreign Relations (CFR) published its’ second report on “non-lethal” weapons. It concluded that limited progress had been made in the development and deployment of these weapons since 1995 due to lack of support by senior policymakers and insufficient funding.¹⁶² The report also recommended a substantial increase in funding for research and development arguing:

...there is a high probability of major benefit from a large, urgent investment in nonlethal weapons and technologies, carried out under the commandant of the Marine Corps as the executive agent of the Department of Defense.¹⁶³

International interest in “non-lethal” weapons during the 1990’s centred on the North Atlantic Treaty Organisation (NATO), which in turn was guided by input from the US in the development of its’ research and policy efforts.¹⁶⁴ In 1994 NATO’s Defence Research Group (DRG) group was tasked with assessing the potential of “non-lethal” weapons for NATO peacekeeping and peace support operations.¹⁶⁵ Meanwhile the Advisory Group for Aerospace Research and Development (AGARD), a forum for information exchange on science and technology, began a study entitled *Non-Lethal Means for Diverting or Forcing Non-Cooperative Aircraft to Land*. This report identified a concept of non-lethal air defence (NOLAD) for protecting airspace and enforcing no-fly zones and was primarily focused on anti-materiel technologies.¹⁶⁶ In 1996 NATO held its first conference on “non-lethal” weapons and in May 1997 the Advisory Group for Aerospace Research and Development (AGARD) published a second study addressing lethal and “non-lethal” weapons for peace support operations.¹⁶⁷ As Lower noted at the time:

The study was commissioned to explore innovative means to attack (both lethal and non-lethal), with minimal risk of collateral damage, discrete ground targets from airborne platforms supporting NATO Peace Support Operations. A basic set of 50 lethal, 11 non-lethal, and 4 UAV concepts were identified and analysed in relevant target situations.¹⁶⁸

“Non-lethal” concepts suggested included: the use of crop dusters to deliver irritant chemical weapons or aqueous foams; helicopter as platforms for a variety of weapons such as nets, acoustic systems, kinetic impact rounds, and “dazzling” laser weapons; and the use of unmanned aerial vehicles (UAVs) as delivery systems.¹⁶⁹ By September 1997, the work of NATO’s Defence Research Group (DRG) had led to the establishment of an NLW Policy Team.¹⁷⁰ Two years later, in September 1999, NATO issued its’ policy on non-lethal weapons, which was closely aligned with the US Department of Defense’s 1996 policy.¹⁷¹

Other collaboration on “non-lethal” weapons occurred directly between the US Joint Non-Lethal Weapons Directorate (JNLWD) and interested countries in the late 1990’s. As the JNLWD’s 1999 Annual Report noted:

Over the past year, the JNLWD had numerous foreign enquiries on DoD Non-Lethal Weapons (NLW) efforts. In response, the Directorate had provided overview briefs to France, Italy, Germany, Republic of Korea, Japan and the United Kingdom (UK), and replied to correspondence from many others such as Australia, Columbia, Sweden, Canada and Norway.¹⁷²

Furthermore the JNLWD signed two information exchange agreements, the first in February 1998 with the UK Ministry of Defense and the second in September 1999 with Israel.¹⁷³ Meetings with the UK, of which there were two in 1998 and one in 1999,¹⁷⁴ had focused on various topics including training and doctrine as well as specific technologies such as anti-personnel landmine alternatives and “dazzling” laser weapons. The UK and the US had starting

planning for a series of joint wargaming exercises on “non-lethal” weapons.¹⁷⁵ Also in the UK Jane’s Information Group had initiated an annual international conference on “non-lethal” weapons, the first of which was held in 1997.¹⁷⁶

4. Irritant Chemical Weapons

Despite their availability as early as the 1970’s there was a greatly increased uptake of oleoresin capsicum (OC) sprays (also known as ‘pepper spray’) by US police departments during the early 1990’s with OC preferred to CS.¹⁷⁷ The publication of a Federal Bureau of Investigation (FBI) study on OC spray in 1989 was the catalyst for this change since it claimed to find no adverse effects in around over 800 subjects exposed to it. Since it was an unregulated product there was a proliferation of manufacturers and large numbers of sprays were marketed to both police and the general public.¹⁷⁸ A 1996 paper on various irritant chemical sprays noted the impact of the FBI study:

Following release of this study, the use of OC sprays became so popular that a 1992 Washington Post article reported over 2000 law enforcement agencies were using pepper sprays. The popularity of OC sprays has now increased so much that current industry estimates indicate at least 15 million defense spray canisters (a majority containing OC) were manufactured in the three year period from 1992 through 1994.¹⁷⁹

However, OC had been widely introduced with little assessment of the potential for adverse health effects.¹⁸⁰ There were a number of in-custody deaths following the use of the sprays by police, which threatened to limit the use of these weapons by police. In response the NIJ funded a study by the International Association of Chiefs of Police, published in 1994, that concluded OC did not cause these deaths.¹⁸¹ The National Institute of Justice funded several other studies of OC sprays during the 1990’s, which reached favourable conclusions about effectiveness and associated health risks.¹⁸² However, Rappert’s subsequent analysis of the major studies conducted on OC during the 1990’s concerning the health effects, risk of in-custody death, and effectiveness, indicated that there was a lack of balanced and objective assessment. Research with significant limitations was cited to reinforce favourable assessments of OC whilst research reaching unfavourable conclusions was disregarded.¹⁸³ A technical report on OC published by the US Army’s Edgewood Research, Development and Engineering Center (ERDEC) in 1994 expressed concerns over adverse health effects and the lack of data available for effects for varied populations.¹⁸⁴ In a worrying twist to the debate in 1996, the agent overseeing the original 1989 FBI study of OC was found guilty of a receiving a bribe from the manufacturers of the CAP-STUN brand sprays used in the tests.¹⁸⁵ Another issue that clouds assessments of the safety and effectiveness of OC sprays is the variation between different sprays in terms of concentrations of active ingredient, composition of carrier substances, and types of delivery system.¹⁸⁶

Some research on alternatives to OC and CS irritant agents was funded by the National Institute of Justice (NIJ) in 1998 and 1999. Researchers assessed the potential of a compound studied by the US Army in the early

1970's initially designated EA 4923.¹⁸⁷ EA 4923 is a potent irritant and volatile liquid compound called tropilidene, since given the code CHT.¹⁸⁸

5. Electrical Weapons

One of the most significant developments in “non-lethal” weaponry during the 1990's was the modification of a long established electrical weapon technology, the Taser. The changes originated not from government sponsored research endeavours but rather from the private sector. In 1993 a new company, Air Taser, later Taser International,¹⁸⁹ entered the US market for Taser electrical weapons. At the time Tasertron had a legal agreement that made it the only company allowed to sell Tasers to law enforcement agencies and it did not sell its products to the civilian market. Air Taser launched their first model in January 1995, the Air Taser 34000, which had the same power output of 5-7 watts as the Tasertron two-shot models, the TE85 and TE95 and its' single-shot model, the TE93 Patrol Taser. The Air Taser 34000 was also a single-shot device and, like the Tasertron TE93, had the capability to be used in ‘touch stun’ mode. It was smaller and lighter than the TE93. However, the most significant difference between the two was that the Air Taser cartridges employed compressed nitrogen to launch the barbed projectiles whereas Tasertron cartridges used gunpowder. This meant that Air Tasers were not classified as firearms by the US Bureau of Alcohol, Tobacco and Firearms (ATF) and therefore could be widely sold to the general public as “self defence” weapons.¹⁹⁰ This was the market targeted at the outset by the founder of Air Taser, Rick Smith, who described his strategy in a presentation to a US conference on “non-lethal” weapons in November 1996:

Since the vast majority of firearm related fatalities [in the US] are committed by armed citizens (vis-a-vis police officers), the greatest societal gains will be realized by implementing policies that effect migration towards non-lethals by the general public.¹⁹¹

Unsurprisingly perhaps, Smith's analysis of available “non-lethal” weapons technology considered electrical weapons to be most suitable for implementing this ostensibly altruistic shift in the armoury of the US citizen. Nevertheless, although powerful lobby groups such as the National Rifle Association have assisted US citizens in maintaining their 18th century “right to bear arms”, there proved to be a substantial civilian market for electrical weapons to supplement them. By late 1996, according to the company, “tens of thousands” of Air Taser units had been sold to the general public.¹⁹² In 1997 Air Taser launched the Auto Taser, an anti-theft device similar to a steering-wheel lock with an electrical discharge device incorporated, but it was not a commercial success.¹⁹³ In early 1998, with the expiry of Tasertrons' exclusive patent agreement for sales to law enforcement agencies, the situation changed and Air Taser, renamed Taser International, entered the law enforcement market.

By 1999, according to Tasertron, over 400 law enforcement agencies were using its Taser electrical weapons and there had been over 50,000 deployments of these weapons.¹⁹⁴ The Victoria Police Department in Canada

had also conducted a six month trial using Tasertron Tasers beginning in December 1998. This was significant because until then Tasers and similar devices had been prohibited weapons in Canada. The trial was viewed favourably and Victoria Police subsequently adopted Taser devices.¹⁹⁵

Meanwhile Taser International had begun to develop a new Taser weapon with a much higher power output of 26 watts, four times more powerful than the existing 5-7 watt devices, which was also redesigned to look like a handgun. Tests conducted by the company showed that the prototype device, which would later be called the M26 Advanced Taser, was more effective at incapacitating victims, including those individuals who had been able to fight through the effects of lower powered devices.¹⁹⁶ The first thirty M26 Advanced Tasers were sold to the New York City police department for field testing in November 1999.¹⁹⁷ This modification to the Taser design would prove to be very significant in terms of increased deployment of electrical weapons in the US and elsewhere. However, one concern noted just prior to its' introduction was that all existing research on the human effects of electrical weapons was based around the lower power 5-7 watt devices.¹⁹⁸

In addition to hand held electrical weapons, Tasertron had been conducting research and development of an electrical landmine, in collaboration with Primex Aerospace Company and the Army's Armament Research, Development and Engineering Center (ARDEC), as part of the Joint Non-Lethal Weapons Directorate's (JNLWD) initiative on "non-lethal" alternatives to anti-personnel landmines. They developed a prototype Taser Area Denial Device (TADD) that fired seven sets of Taser cartridges in a 120 degree arc by remote control. Subsequently they also developed a prototype multi-shot system called the Taser Sentinel that incorporated a modified Taser Area Denial Device and a camera to fire cartridges by remote control at varied angles.¹⁹⁹

Other research funded by the DOJ-DOD collaborative effort on "non-lethal" weapons sought to get round the range limitations of hand-held Tasers with trailing wires by developing a wireless electrical projectile. The research was carried out by Jaycor Company who, by 1996, had developed a projectile called the "Sticky Shocker". The prototype contained a battery pack to power the electrical discharge that would be delivered when it stuck to the target person. A compressed gas launcher system was also developed to fire the projectile. Tests on the blunt impact force by the company apparently showed that it delivered similar kinetic impact to rubber bullets and 'bean bag' rounds.²⁰⁰ It therefore shared the limitations of these kinetic impact projectiles in terms of potential for severe injury. The NIJ-sponsored assessment of the "Sticky Shocker" conducted by the Human Effects Advisory Panel at Pennsylvania State University and published in 1999 did not review the weapon favourably warning that it had the potential to kill or cause serious injury from the impact and that:

The Shocker's electrical insult could cause acidosis [increase in acidity of the blood], which can lead to death. It also has a high probability of skin burns. The Sticky Shocker's electrical insult also may cause other serious injuries. The problem is, little

data exists regarding how electrical current passes through the human body. There is also no data on the combined effects of blunt impact and electrical insult.²⁰¹

Of course, this knowledge gap concerning the interaction of electrical currents with the human body applied to all electrical weapons at the time.

During the 1990's Amnesty International raised concerns over the use of electrical weapons for torture. In a 1997 report, *Arming the Torturers: Electro-shock Torture and the Spread of Stun Technology*, the organisation described reports of torture with hand-held electrical weapons in numerous countries, noting:

The portability and ease with which electro-shock weapons can be concealed, means that the incapacitating, painful and other effects of such weapons may be attractive to unscrupulous security, police and prison officers, especially since traces of their use on victims can afterwards be difficult to detect. Aware of the growing international marketing of electro-shock weapons, Amnesty International is publishing this report to warn the international community of this danger.²⁰²

6. Other Technologies

There were no major developments in kinetic energy impact projectiles during the 1990's. In 1997 the US National Institute Justice (NIJ) began funding a project to assess the potential of the ring airfoil projectile (RAP), which had been developed by the US Army in the 1970's under the name Ring Airfoil Grenade (RAG), for use by law enforcement agencies. The renewed research effort sought to develop the version that would release a three foot diameter cloud of irritant chemical agent on impact in addition to the blunt impact force of the rubber projectile. In the 1970's CS had been the payload proposed but by the late 1990's OC was under consideration. The project was ongoing at the end of the 1990's.²⁰³ In the UK, research was ongoing on a replacement for the L5A6/7 plastic bullets.²⁰⁴

Substantial work on chemical-based "non-lethal" weapons had been conducted during this period including further development of lubricants, foams, malodorants, and incapacitating agents. The NIJ funded a project in 1992 to assess the application of sticky foam, which had been developed at Sandia National Laboratories in the late 1970's and patented in 1980,²⁰⁵ for use to subdue to prisoners. By 1994 scientists had conducted toxicology tests and developed a prototype delivery system, with input from the American Correctional Association and the National Sheriffs' Association.²⁰⁶ These systems were subsequently offered to the Marines to take to Somalia in 1995 who used them to create temporary barriers since the foam had been considered too dangerous for use against people during training. The major risk was that airways would be blocked causing suffocation.²⁰⁷ The foam also presented problems in terms of cleaning up afterwards. A 1996 conference paper by the developers noted: "Using mineral oil to remove sticky foam from skin requires significant mechanical effort and approximately 20 seconds per square inch."²⁰⁸ In late 1994 the NIJ also funded Sandia to study the use of aqueous foam in prisons and the laboratory subsequently developed a prototype cell extraction system employing aqueous foam laced with OC

irritant agent. They also conducted a feasibility study of releasing this irritant foam on a large scale to fill the entire stairwell of a prison building in the event of a large scale disturbance.²⁰⁹

Research on slippery substances was another development effort inherited by the Joint Non-Lethal Weapons Directorate (JNLWD) when it was established. New research at the US Army Edgewood Chemical and Biological Center (ECBC), then ERDEC, had begun in 1996 with the screening of a variety of water-activated polyacrylimide and polyacrylic acid-based substances and resulted in the selection of several commercial compounds for further consideration, namely Agefloc WT 603 (CPS Chemical) and various Percol powders (Allied Colliods). After testing, logistical considerations in terms of quantities required for effective application, requirement for water, and dissemination methods led to collaboration with the Southwest Research Institute (SwRI) in early 1999 to consider a wider range of chemical compounds.²¹⁰

Research on malodorant chemicals at Edgewood Chemical and Biological Center (ECBC), funded by the JNLWD in 1998, was ongoing to deliver an “odour index” relating to the effects of odours on specific populations, techniques for microencapsulating these chemicals, and a prototype hand-held delivery system.²¹¹ These agents were being considered as potential payloads for a variety of “non-lethal” delivery systems under development at the time. Initial research, conducted in collaboration with the Monell Chemical Senses Center in Philadelphia, involved assessing the most aversive malodorant chemical mixtures and ascertaining the response to a given mixture at varied concentrations. Two chemical mixtures, “US Government Bathroom Malodor” (the smell of human faeces) and “Who me?” (the smell of body odour), were found to be the most unpleasant. Some of the symptoms reported by human volunteers included nausea and gagging.²¹²

Research and development of chemical incapacitating agents and associated delivery systems continued during the 1990's. An Army programme to develop an advanced riot control agent device (ARCAD) employing an incapacitating chemical agent was ongoing in the early 1990's. This programme had close connections with a National Institute of Justice (NIJ) effort on incapacitating chemicals, initial research having been conducted at the US Army's Edgewood facility. Further research on agents and delivery systems was carried out by Lawrence Livermore National Laboratory during the mid-1990's. Opioid drugs, namely fentanyl analogues, were the major agents under consideration by both the Army and the NIJ, with the military also clearly interested in alpha-2 adrenergic drugs to induce sedation. Both groups were investigating the use of agent-antidote combinations in an attempt to control adverse effects such as respiratory depression. The ARCAD programme was developing a grenade-like delivery system²¹³ whilst the LLNL research was investigating transdermal (through skin) delivery systems for use against individuals.²¹⁴

Research programmes on acoustic weapons were conducted throughout the 1990's. The main programmes were conducted through collaboration

between the US Army Armament Research, Development and Engineering Center (ARDEC) and Scientific Applications & Research Associates (SARA) Inc. investigating various acoustic weapons concepts including a high power infrasound generator. The US Air Force laboratories were also involved in investigating the effects of infrasound through a contract funded by the National Institute of Justice (NIJ). Development of a device to generate vortex rings was carried out at ARDEC and the Army Research Laboratory. However, in 1998 and 1999 both the infrasound generator and the vortex ring generator projects ended with the closure of Non-Lethal Acoustic Weapons (NLAW) programme by the JNLWD after almost ten years of research and development work that had yielded little more than a prototype infrasound generator that failed to produce predictable, repeatable effects at the minimum required range.²¹⁵ Nevertheless Army research and development of other acoustic weapons persisted,²¹⁶ as did interest in the commercial sector including at SARA.²¹⁷

Development of anti-personnel directed energy weapons presented as “non-lethal” expanded greatly during the 1990’s. In the early 1990’s several tactical laser weapons programmes in the US and elsewhere had developed portable lasers designed to blind and to degrade sensors and optics. Despite their destructive and irreversible effects on the human eye some of these systems were even presented as “non-lethal”.²¹⁸ International pressure led to a ban on laser weapons intentionally designed to blind in 1995. Subsequently attention, in terms of these low energy lasers, turned to those designed to temporarily blind or “dazzle” a person. A number of prototype devices were produced including the Saber 203 Illuminator, a red diode laser developed by the US Air Force Phillips Laboratory prior to the ban on blinding lasers, which was taken to Somalia in 1995 by the Marine Corps. This device was eventually discarded in 1999, in part due to concerns over eye safety.²¹⁹ This is an enduring concern with these systems since lasers that can cause visual disturbance or flash blindness for a brief exposure at a certain distance can cause permanent eye damage at shorter ranges.²²⁰ A comparable device called the Laser Dissuader, also employing a red diode laser, was developed by Science and Engineering Associates (SEA). In the late 1990’s the Air Force tested a number of these weapons including the Dissuader and by 1999 had begun to develop, with Science and Engineering Associates, a device incorporating similar optics called the Hinder Adversaries with Less-than-lethal Technology (HALT) as a replacement for the Saber 203 weapon.²²¹ Other weapons developed included the Laser Dazzler, a green solid-state laser weapon developed by LE Systems with funding from the DARPA-administered joint DOJ-DOD initiative on “non-lethal” weapons.

Air Force research on using millimetre wave electromagnetic energy to heat up human skin and cause a painful burning sensation, which they termed Active Denial Technology (ADT), had been ongoing throughout the 1990’s and this research and development was given high priority by the Joint Non-Lethal Weapons Directorate (JNLWD) in their initial review of “non-lethal” weapons programmes. There was also investigative research being conducted on the use of high energy chemical lasers for “non-lethal” weapons applications such as the development of pulsed lasers to create plasma

induced shock-waves. Nevertheless, proposed “non-lethal” directed energy weapons formed a very small part of the larger US programme (and indeed programmes in other countries) to develop technological alternatives or complements to conventional weapons. The vast majority of funding, which had decreased considerably in the 1990’s in comparison to efforts under the Strategic Defense Initiative (SDI) in the 1980’s, was going towards development of high-energy laser weapons, such as the Airborne Laser (ABL) intended to shoot down ballistic missiles, and high-power microwave (HPM) weapons designed to destroy electronic equipment.²²²

Many of the “non-lethal” weapons programmes inherited from the Army and prioritised by the Joint Non-Lethal Weapons Directorate (JNLWD) in the late 1990’s involved the development of new or adapted delivery systems, compatible with existing conventional weapons, for firing a variety of payloads at extended ranges. This included the development of grenades, mortars and other munitions, in addition to a dispersal device to deliver chemical agents over large areas. Unmanned aerial vehicles, which had gained greater acceptance in the late 1990’s in particular following their use in Kosovo in 1999, and were being developed primarily for carrying sensors or for lethal weapons delivery, were also under consideration for “non-lethal” weapons delivery.²²³ In the commercial sector one significant development was the PepperBall System, essentially a paintball-type frangible projectile for delivering various payloads but primarily OC powder. It had been developed by Jaycor Tactical Systems and used for the first time by the Seattle Police Department during protests of the World Trade Organisation meeting in the city in 1999.²²⁴

7. Legal Issues

There were a number of international legal developments during the 1990’s impacting the development of proposed “non-lethal” weapons technologies. Following an initial meeting of experts convened by the International Committee of the Red Cross (ICRC) to assess the dangers from the development of anti-personnel lasers designed to blind in 1989 further investigation was recommended. Three follow-on meetings of experts were held in 1990 and 1991. The first of these carried out a detailed study of the technical aspects of laser weapons and the medical effects on the eye, the second assessed the effects of different types of battlefield injuries and the problems associated with blindness, and the final meeting examined whether, on the basis of findings from the previous meetings, laser weapons designed to blind were already illegal.²²⁵ The majority view of participants was that legal regulation to ban these weapons through the negotiation of an additional Protocol to the 1980 Convention on Certain Conventional Weapons (CCW) would be desirable. In the face of opposition from some States who were actively developing these weapons and indifference from others, in 1993 the ICRC published the findings of its’ four meetings in order to gain international support for a ban. A Review Conference of the CCW was called for 1995, primarily to address the issue of anti-personnel landmines. The Swedish Government and the ICRC used the opportunity to raise the issue of blinding lasers during meetings of government experts preceding the review

conference in late 1994 and early 1995. At this stage the only country that declared opposition to a new Protocol banning these weapons was the United States. The ICRC expanded its campaign to consolidate support for the proposed Protocol emphasizing, amongst other things, the potential for widespread proliferation due to the small size and relatively cheap nature of these weapons.²²⁶ Significantly, Human Rights Watch published research in May 1995 detailing a number of US laser weapons systems under development with the capability to blind.²²⁷ Meanwhile a small group of US politicians sought to raise the issue with the Clinton administration. This led to a reversal of US policy several weeks before the opening of the CCW Review Conference in late September 1995.²²⁸ At the Review Conference an Additional Protocol, *Protocol IV on Blinding Laser Weapons*, was negotiated and agreed. Article I of the Additional Protocol, which entered into force in 1998, stated:

It is prohibited to employ laser weapons specifically designed, as their sole combat function or as one of their combat functions, to cause permanent blindness to unenhanced vision, that is to the naked eye or to the eye with corrective eyesight devices. The High Contracting Parties shall not transfer such weapons to any State or non-State entity.²²⁹

Furthermore, Article II required that in using other laser systems, such as rangefinders and target designators, countries "...shall take all feasible precautions to avoid the incidence of permanent blindness to unenhanced vision."²³⁰

There was initial optimism that development of laser weapons intentionally targeting the eye would cease with the demise of certain existing weapons programmes.²³¹ However this was short-lived as it emerged that attention had shifted towards the development of so called "dazzling" laser weapons that would, it was envisaged, cause temporary blindness or visual disturbance without permanent adverse effects on the eyes and these were being promoted as a major "non-lethal" weapons technology for the police and the military.²³²

Another very significant legal development during this period was the negotiation of the Chemical Weapons Convention (CWC). After protracted negotiations throughout the 1980's the Convention was finally agreed in late 1992.²³³ It was opened for signature in January 1993 and came in to force in April 1997. Building on the 1925 Geneva Protocol, the CWC bound States "never under any circumstances" to use chemical weapons or to "develop, produce, otherwise acquire, stockpile or retain chemical weapons, or transfer, directly or indirectly, chemical weapons to anyone."²³⁴ However, concerns were immediately raised about ambiguities in the Convention that could weaken its' prohibitions, particularly in relation to riot control agents (RCAs) and proposed incapacitating chemical agents.²³⁵ The subject of irritant chemical agents or riot control agents (RCAs) had been a contentious one during the negotiations and the text of the Convention reflected a compromise between differing positions.²³⁶ In the convention RCAs were defined as follows:

any chemical not listed in a Schedule, which can produce rapidly in humans sensory irritation or disabling physical effects which disappear within a short time following termination of exposure.²³⁷

Article I of the Convention specifically prohibited the use of riot control agents, such as CS and OC, as a “method of warfare”. This was to prevent military use of these agents of the type that was seen during US operations in the Vietnam War as well as escalation to “lethal” agents. However, what constituted a “method of warfare” was not defined in the Convention. Other ambiguities lay in the “purposes not prohibited” by the Convention which included the use of toxic chemicals for “law enforcement including domestic riot control purposes”, Article II 9(d).²³⁸ This permitted the continued use of irritant chemical weapons by police on a domestic basis, as had become commonplace years before. However, “law enforcement” was not defined anywhere in the convention and neither were law enforcement chemicals. This lack of definition left room for differing interpretations of the Convention concerning not only the use of toxic chemical agents by the military or police in the grey area between warfare and domestic law enforcement, such as peacekeeping and peace enforcement, but also the types of chemicals that could be used.²³⁹ As the March 1994 editorial of the *Chemical Weapons Convention Bulletin* noted:

Some, by no means a majority, of the negotiating states wished to protect possible applications of disabling chemicals that would either go beyond, or might be criticized as going beyond, applications hitherto customary in the hands of domestic police forces.²⁴⁰

One of the principal disputes was the longstanding US position, not shared by any other States, that they did not consider riot control agents (RCAs) to be chemical weapons.²⁴¹ In addition, when the US Senate ratified the CWC it made clear the US position that the Convention would not detract from the 1975 US law, Executive Order 11850, which permitted the use of RCAs in certain situations, and maintained the right to use them against combatants in several types of military operation.²⁴² However, both the assertion of the right to use RCAs against combatants and two of the provisions in EO 11850 (use of RCAs against combatants employing civilians as human shields, and use against combatants attempting to capture downed aircrew or escaping POWs) are not compatible with the CWC’s prohibition on the use of RCAs as a method of warfare.²⁴³ This isolated US position was defended in a preliminary legal review of proposed chemical “non-lethal” weapons produced by the US Navy Office of the Judge Advocate General in November 1997 that was requested by the Joint Non-Lethal Weapons Directorate (JNLWD) shortly after the Chemical Weapons Convention came into force.²⁴⁴

The legal review also considered incapacitating chemical agents briefly, suggesting that such agents “may also be RCAs”. This contradicted accepted wisdom distinguishing incapacitating agents, with their central mechanism of action and profound effects, from riot control agents, which act peripherally as sensory irritants. It also contradicted prior recognition by the US of three main categories of chemical weapons: lethal, incapacitating, and riot control agents. Nevertheless, with the negotiation of the CWC, the US had begun to describe

incapacitating agents as “advanced riot control agents” or “calmatives” in what was a disingenuous exercise to facilitate their continued development by the military in the face of the CWC’s prohibition of chemical weapons. The legal review document acknowledged, rather naively, that these incapacitating agents “may rely on their toxic properties to have a physiological effect on humans”, arguing that they would then only be permitted for “purposes not prohibited” by the Convention. Of course this brought the issue around full-circle to the ambiguity in the Convention over what constituted “law enforcement purposes” and whether chemicals used for these purposes were limited to riot control agents. The preliminary legal review also put forward the argument that malodorous chemicals were not restricted by the CWC because they “do not rely on their toxic properties.”²⁴⁵ However, the proposed action of malodorants as sensory irritants would seemingly class them as riot control agents.

Another legal development that affected “non-lethal” weapons development was the negotiation of the 1997 *Convention on the Prohibition of the Use, Stockpiling, Production and Transfer of Anti-Personnel Mines and on their Destruction* or the Ottawa Treaty.²⁴⁶ The US was not a signatory to this Convention but later said that it would sign in 2006 if alternatives to land mines could be developed.²⁴⁷ A US Department of Defense initiative to develop alternatives to anti-personnel landmines had begun in 1996 and the Joint Non-Lethal Weapons Directorate (JNLWD) was tasked with developing “non-lethal” alternatives.²⁴⁸

A further development relevant to police consideration of “non-lethal” weapons was the adoption of the United Nations *Basic Principles on the Use of Force and Firearms by Law Enforcement Officials* in 1990. Although not legally binding, these principles set out moral and practical guidance to police forces. General provisions 2, 3 and 4 addressed “non-lethal” weapons advising that governments and law enforcement agencies should develop these weapons as *alternatives* to firearms “... with a view to increasingly restraining the application of means capable of causing death or injury to persons.”²⁴⁹ However the Principles cautioned that such weapons should be “carefully evaluated” and “carefully controlled”, and furthermore that law enforcement officials should “as far as possible, apply non-violent means before resorting to the use of force and firearms.”²⁵⁰

8. Conclusion

It was not until the end of the Cold War with a shift in security priorities that “non-lethal” weapons for the military began to be considered seriously by US policymakers, and the subject matter broadened beyond the search for new police weaponry. In the early 1990’s the Defense Advanced Research Projects Agency (DARPA) had become interested in technologies including “non-lethal” weapons to aid the increasing number of operations other than war, such as peacekeeping. However, with no overall policy, many research and development activities were characterised by opportunistic and secretive endeavours at the Department of Energy’s national laboratories, in particular at Los Alamos. The US Army’s Low Collateral Damage Munitions (LCDM)

programme, seeking weapons with variable effects from “lethal” to “non-lethal”, collaborated with Los Alamos as well as the Army’s Edgewood Research Development and Engineering Center (ERDEC). Advocacy by a handful of proponents in the early 1990’s eventually led to a draft Department of Defense (DOD) policy on “non-lethal” weapons in 1994 and a memorandum of understanding between the Department of Justice and DOD for a research programme into technologies such as “non-lethal” weapons that could be used for military operations other than war as well as domestic policing. With the formalisation of policy in 1996 and the establishment of the Joint Non-Lethal Weapons Program (JNLWP), disparate military research efforts were brought together under the control of the Joint Non-Lethal Weapons Directorate (JNLWD). Inherited programmes were augmented with ambitious efforts to pursue new technologies. However, the perceived revolutionary potential of new “non-lethal” weapons to restrict the use of “lethal” force, on which they had been sold, was not reflected in the cautious DOD policy that seemingly solidified their position as adjuncts rather than alternatives to “lethal” force. Furthermore, the policy specifically endorsed their use as force multipliers, contradicting the central concept of minimizing fatalities and permanent injury.

In the policing sphere high profile events, in particular the disaster at Waco, had given impetus to the expanded efforts of the Department of Justice Less-than-Lethal Technology Program. The National Institute of Justice (NIJ) initially sought technical support from the Department of Energy (DOE), funding research and development at the DOE national laboratories, and then collaborated with the Department of Defense on dual-use technologies. A significant amount of funded research necessarily focused on safety and effectiveness concerns over existing police weaponry but NIJ also supported the development of acoustic, directed energy, and incapacitating agent weapons.

With the growing military interest in “non-lethal” weapons more research was conducted on these unconventional technologies with mixed results. Decade long research and development of acoustic weapons came to nothing but work on directed energy weapons led to new devices. Prototype “dazzling” laser weapons emerged in the mid-1990’s but concerns remained over their potential to cause permanent eye damage and their limited effectiveness. The classified Active Denial Technology, under development by the Air Force, was given high priority by the JNLWD. Other concepts based on high energy lasers were at the very early stages of development. In the early 1990’s the Army intended to proceed with the full-scale development of a munition delivering incapacitating chemical agents but the negotiation of the Chemical Weapons Convention (CWC) halted the project. Nevertheless related research and development of incapacitating chemical weapons continued under the auspices of the Department of Justice and military interest persisted.

The most significant developments, in terms of new weaponry emerging during this period, were not novel military systems but variations of existing technologies marketed to both the police and the general public. Due to safety claims, oleoresin capsicum (OC) became hugely popular, eclipsing CS

as the irritant chemical weapon of choice for US police forces. A new design of the Taser electrical weapon opened up a significant civilian “self defence” market due to a technicality. Subsequently, the commercial contest for the police market led to the development of a higher-power Taser, which would soon be very widely deployed. Advocates had predicted revolutionary developments based around novel technologies but these pronouncements seemed premature with the organisation of the military programme only recently established and limited results from ambitious research and development efforts.

¹ Quotation marks are used in recognition of enduring concerns over use of the term ‘non-lethal’ or other terms related to lethality (such as ‘less-lethal’) when applied to a weapon or group of weapons.

² Davison, N. (2006) *The Early History of “Non-Lethal” Weapons*. Occasional Paper No. 1. Bradford: University of Bradford, Department of Peace Studies, Bradford Non-Lethal Weapons Research Project.

³ As with Occasional Paper No. 1 this paper necessarily this paper focuses on events in the US, in part because it has led the way in this field but also because sources of information on US activities are more readily available. However, it should be noted that research and development on “non-lethal” weapons in other countries also expanded during this period.

⁴ Fidler, D. (2005) The meaning of Moscow: “Non-lethal” weapons an international law in the early 21st century. *International Review of the Red Cross*, Vol. 87, No. 859, September 2005, pp. 525-552.

⁵ Advocate literature during the 1990’s included: Morris, C. and Morris, J. (1991) *Nonlethality: A Global Strategy White Paper*. Washington, DC: US Global Strategy Council; Council on Foreign Relations (1995) *Non-Lethal Technologies: Military Options and Implications. Report of an Independent Task Force*. New York: Council on Foreign Relations; Morehouse, D. (1996) *Nonlethal Weapons: War without Death*. Westport: Praeger; Alexander, J. (1999) *Future War: Non-Lethal Weapons in Twenty-First-Century Warfare*. New York: St. Martin’s; Copernoll, M. (1999) The Nonlethal Weapons Debate. *Naval War College Review*, Vol. LII, No. 2, Spring 1999, pp. 112-131; Garwin, R. (1999) *Nonlethal Technologies: Progress and Prospects. Report of an Independent Task Force*. New York: Council on Foreign Relations.

⁶ Sceptic literature during the 1990’s included: Aftergood, S. (1994) The soft-kill fallacy. *Bulletin of the Atomic Scientists*, Vol. 50, No. 5, September-October 1994; Dando, M. (1996) *A New Form of Warfare: The Rise of Non-Lethal Weapons*. London: Brassey’s; Coupland, R. (1997) “Non-lethal” weapons: precipitating a new arms race. *British Medical Journal*, Vol. 315, No. 72, 12 July 1997; Lewer, N. and Schofield, S. (1997) *Non-Lethal Weapons. A Fatal Attraction?* London: Zed Books; Wright, S. (1998) *An Appraisal of Technologies of Political Control*. Working Document (Consultation Version), PE 166 499. Luxembourg: European Parliament, Directorate General for Research, Scientific and Technological Options Assessment (STOA), 6 January 1998.

⁷ Ackroyd, C., Margolis, K., Rosenhead, J. and Shallice, T. (1977) *The Technology of Political Control*. Penguin Books: Middlesex, UK; Wright, S. (1978) *New Police Technologies: An exploration of the social implications and unforeseen impacts of some recent developments*. *Journal of Peace Research*, Vol. 15, No. 4, pp. 305-322.

⁸ Fidler, D. (2005) The meaning of Moscow: “Non-lethal” weapons an international law in the early 21st century. *International Review of the Red Cross*, Vol. 87, No. 859, September 2005, pp. 525-552.

⁹ Pilant, L. (1993) *Less-than-Lethal Weapons: New Solutions for Law Enforcement*. *Science and Technology*, Washington, DC: International Association of Chiefs of Police, December 1993.

¹⁰ Hart, S. (2002) *Statement before The Subcommittee on Aviation, Committee on Transportation and Infrastructure, U.S. House of Representatives*. Washington, DC: US House of Representatives.

¹¹ Pilant, L. (1993) *Less-than-Lethal Weapons: New Solutions for Law Enforcement*. *Science and Technology*, Washington, DC: International Association of Chiefs of Police, December 1993.

¹² National Institute of Justice (1995) *NIJ Awards in Fiscal Year 1994*. Washington DC: Department of Justice, National Institute of Justice.

¹³ Office of Technology Assessment (1991) *Technology Against Terrorism: The Federal Effort*, OTA-ISC-487. Washington DC: Government Printing Office. July 1991, pp. 95-96.

¹⁴ Pilant, L. (1993) *Less-than-Lethal Weapons: New Solutions for Law Enforcement*. *Science and Technology*, Washington, DC: International Association of Chiefs of Police, December 1993.

- ¹⁵ Andresen, B. and Grant, P. (1997) *Dose Safety Margin Enhancement for Chemical Incapacitation and Less-than-Lethal Targeting, NIJ Final Report and Recommendations*. Forensic Science Center R-Division, Nonproliferation, Arms Control, and International Security Directorate, Lawrence Livermore National Laboratory. January 1997; Perry Robinson, J. (2003) *Disabling Chemical Weapons: A Documented Chronology of Events, 1945-2003*. Harvard-Sussex Program, University of Sussex, unpublished, version dated 8 October 2003, p. 93.
- ¹⁶ Scott, S. (1997) Sticky foam as a less-than-lethal technology. *Proceedings of SPIE*, Volume 2934, pp. 96-103; Goolsby, T. (1997) Aqueous foam as a less-than-lethal technology for prison applications. *Proceedings of SPIE*, Volume 2934, pp. 86-95.
- ¹⁷ Office of Technology Assessment (1991) *Technology Against Terrorism: The Federal Effort*, OTA-ISC-487. Washington, DC: Government Printing Office. July 1991, p. 96.
- ¹⁸ *Ibid.*, pp.141-142.
- ¹⁹ Lewer, N. (1997) *Bradford Non-Lethal Weapons Research Project (BNLWRP) Research Report No. 1*. Bradford: University of Bradford, Department of Peace Studies.
- ²⁰ Seaskate, Inc. (1998) *The Evolution and Development of Police Technology*. A Technical Report prepared for The National Committee on Criminal Justice Technology, National Institute of Justice, Grant 95-IJ-CX-K001(S-3). Washington, DC: Department of Justice, National Institute of Justice, p. 46.
- ²¹ Pilant, L. (1993) Less-than-Lethal Weapons: New Solutions for Law Enforcement. *Science and Technology*, Washington, DC: International Association of Chiefs of Police, December 1993.
- ²² *Ibid.*
- ²³ *Ibid.*
- ²⁴ National Institute of Justice (1994) *25 Years of Criminal Justice Research*, NCJ 151287. Washington DC: Department of Justice, National Institute of Justice. December 1994, p. 52.
- ²⁵ National Institute of Justice (1997) *Department of Justice and Department of Defense Joint Technology Program: Second Anniversary Report*, NCJ 164268. Washington DC: Department of Justice, National Institute of Justice.
- ²⁶ Department of Defense, Department of Justice (1994) *Memorandum of Understanding between Department of Defense and Department Of Justice On Operations Other Than War and Law Enforcement*, 20 April 1994. Available March 2007 at: <http://www.namebase.org/foia/mou01.html>
- ²⁷ Between 1993 and 1996 the agency was referred to as the Advanced Research Projects Agency (ARPA).
- ²⁸ National Institute of Justice (1997) *Department of Justice and Department of Defense Joint Technology Program: Second Anniversary Report*, NCJ 164268. Washington DC: Department of Justice, National Institute of Justice.
- ²⁹ Seaskate, Inc. (1998) *The Evolution and Development of Police Technology*. A Technical Report prepared for The National Committee on Criminal Justice Technology, National Institute of Justice, Grant 95-IJ-CX-K001(S-3). Washington DC: Department of Justice, National Institute of Justice, p. 37.
- ³⁰ US Supreme Court (1996) *Koon v. United States (94-1664)*, 518 U.S. 81; Rappert, B. (2004) MORALIZING VIOLENCE: Debating the Acceptability of Electrical Weapons. *Science as Culture*, Volume 13, Number 1, pp. 3-35; Rejali, D (2003) *Violence You Can't See*. Reed College editorial, available March 2007 at: <http://www.collegenews.org/x3015.xml>; Also see the police use of force reports from the Rodney King incident, available March 2007 at: <http://www.law.umkc.edu/faculty/projects/ftrials/lapd/kingforce.html>
- ³¹ Pilant, L. (1993) Less-than-Lethal Weapons: New Solutions for Law Enforcement. *Science and Technology*, Washington D.C.: International Association of Chiefs of Police, December 1993.
- ³² Rappert, B. (2004) MORALIZING VIOLENCE: Debating the Acceptability of Electrical Weapons. *Science as Culture*, Volume 13, Number 1, pp. 3-35.
- ³³ Wood, D. (2002) L.A.'s darkest days. *Christian Science Monitor*, 29 April 2002.
- ³⁴ Mendel, W. (1996) *Combat in Cities: The LA Riots and Operation Rio*. Foreign Military Studies Office, Fort Leavenworth, KS, July 1996; Rasmussen, M. (1999) The Military Role in Internal Defense and Security: Some Problems. Occasional Paper #6, The Center for Civil-Military Relations, Naval Postgraduate School, Monterey, CA, October 1999.
- ³⁵ Pilant, L. (1994) Adding Less-than-Lethal Weapons to the Crime-Fighting Arsenal. *The Journal*.
- ³⁶ Seaskate, Inc. (1998) *The Evolution and Development of Police Technology*. A Technical Report prepared for The National Committee on Criminal Justice Technology, National Institute of Justice, Grant 95-IJ-CX-K001(S-3). Washington, DC: Department of Justice, National Institute of Justice, p. 37.

³⁷ Department of Justice (1993) *Report to the Deputy Attorney General on the Events at Waco, Texas, February 28 to April 19, 1993*. Washington, DC: Department of Justice. Part XIII. The Aftermath of the April 19 Fire. Available March 2007 at:

<http://www.justice.gov/05publications/waco/wacothirteen.html>

³⁸ *Ibid.*, Part XI. Planning and Decision-making Between March 23 and April 19, 1993. Available March 2007 at: <http://www.justice.gov/05publications/waco/wacoeleven.html>

³⁹ *Ibid.*, Part XII. The Events of April 19, 1993. Available March 2007 at:

<http://www.justice.gov/05publications/waco/wacotwelve.html>

⁴⁰ Walsh, E. (1999) FBI Releases Second Waco Videotape. *The Washington Post*, 4 September 1999.

⁴¹ *Ibid.*, Executive Summary. Available March 2007 at:

<http://www.justice.gov/05publications/waco/wacoexec.html>

⁴² Koplow, D. (2005) Tangled up in Khaki and Blue: Lethal and Non-Lethal Weapons in Recent Confrontations. *Georgetown Journal of International Law*, Vol. 36, No. 3, p. 761.

⁴³ Tapscott, M. (1993) DOD, Intel Agencies Look at Russian Mind Control Technology, Claims FBI Considered Testing on Koresh. *Defense Electronics*, July 1993; Ronson, J. (2004) The Men Who Stare at Goats. Oxford: Picador, pp. 189-206; The scientist in question has since established the 'Psychotechnology Research Institute' in Russia. Web site available March 2007 at:

<http://int.psykor.ru/main.php?prka>

⁴⁴ Pilant, L. (1993) Less-than-Lethal Weapons: New Solutions for Law Enforcement. *Science and Technology*, Washington D.C.: International Association of Chiefs of Police, December 1993; Seaskate, Inc. (1998) *The Evolution and Development of Police Technology*. A Technical Report prepared for The National Committee on Criminal Justice Technology, National Institute of Justice, Grant 95-IJ-CX-K001(S-3). Washington, DC: Department of Justice, National Institute of Justice, p. 37.

⁴⁵ Koplow, D. (2005) Tangled up in Khaki and Blue: Lethal and Non-Lethal Weapons in Recent Confrontations. *Georgetown Journal of International Law*, Vol. 36, No. 3, p. 703-808; Koplow, D. (2006) *Non-lethal weapons: the law and policy for the military and law enforcement*. Cambridge: Cambridge University Press, pp. 53-66.

⁴⁶ Rappert, B. (2003) *Non-Lethal Weapons as Legitimizing Forces?: Technology, Politics and the Management of Conflict*. London: Frank Cass, pp. 72-73.

⁴⁷ Oleoresin capsicum (OC) is actually a biological toxin, not a synthetic chemical but has come to be grouped with CS and other irritant chemical weapons as a riot control agent (RCA).

⁴⁸ National Institute of Justice (1994) 25 Years of Criminal Justice Research. Washington, DC: Department of Justice, National Institute of Justice, p. 52.

⁴⁹ Seaskate, Inc. (1998) *The Evolution and Development of Police Technology*. A Technical Report prepared for The National Committee on Criminal Justice Technology, National Institute of Justice, Grant 95-IJ-CX-K001(S-3). Washington, DC: Department of Justice, National Institute of Justice, p. 86.

⁵⁰ Seaskate, Inc. (1998) *The Evolution and Development of Police Technology*. A Technical Report prepared for The National Committee on Criminal Justice Technology, National Institute of Justice, Grant 95-IJ-CX-K001(S-3). Washington, DC: Department of Justice, National Institute of Justice, Part 3; National Institute of Justice (1997) *Department of Justice and Department of Defense Joint Technology Program: Second Anniversary Report*, NCJ 164268. Washington DC: Department of Justice, National Institute of Justice.

⁵¹ Seaskate, Inc. (1998) *The Evolution and Development of Police Technology*. A Technical Report prepared for The National Committee on Criminal Justice Technology, National Institute of Justice, Grant 95-IJ-CX-K001(S-3). Washington, DC: Department of Justice, National Institute of Justice, pp. 87-89; LETAC also includes international representatives from the UK, Canada and Israel.

⁵² *Ibid.*, p.87

⁵³ *Ibid.*

⁵⁴ The awardee in each case was Vice Admiral Burkhalter Jr., the person who had been awarded the prior contract to convene the panel in 1993 and 1994 to assess military technologies for their potential law enforcement application.

⁵⁵ Hart, S. (2002) *Statement before The Subcommittee on Aviation, Committee on Transportation and Infrastructure, U.S. House of Representatives*. Washington, DC: US House of Representatives; This figure is for all "non-lethal" weapons funding and includes anti-vehicle weapons. The figure excluding specifically anti-vehicle projects is an average of \$1.2 million per year, calculated from the funding contracts listed in Table 1.

⁵⁶ This projectile, developed in the 1970's, was originally called the Ring Airfoil Grenade (RAG).

⁵⁷ National Institute of Justice (1997) *Department of Justice and Department of Defense Joint Technology Program: Second Anniversary Report*, NCJ 164268. Washington DC: Department of Justice, National Institute of Justice.

⁵⁸ Only anti-personnel related funding is included in the table. Funding for anti-vehicle weapons is excluded except where it is part of contracts addressing the overall programme. Data are taken from: National Insitute of Justice (1995) *NIJ Awards in Fiscal Year 1994*. Washington, DC: Department of Justice, National Institute of Justice; National Insitute of Justice (1996) *NIJ Awards in Fiscal Year 1995*. Washington, DC: Department of Justice, National Institute of Justice; National Insitute of Justice (1997) *NIJ Awards in Fiscal Year 1996*. Washington, DC: Department of Justice, National Institute of Justice; National Insitute of Justice (1998) *NIJ Awards in Fiscal Year 1997*. Washington, DC: Department of Justice, National Institute of Justice; National Insitute of Justice (1999) *NIJ Awards in Fiscal Year 1998*. Washington, DC: Department of Justice, National Institute of Justice; National Insitute of Justice (2000) *NIJ Awards in Fiscal Year 1999*. Washington, DC: Department of Justice, National Institute of Justice.

⁵⁹ Further description from *NIJ Awards in Fiscal Year 1994*: “The U.S. Department of Energy will provide a technical project director to support research under the Less-Than-Lethal Weapons Program.”

⁶⁰ Further description from *NIJ Awards in Fiscal Year 1994*: “Military and Federal less-than-lethal technologies and related policy issues will be analyzed for their applicability to criminal justice situations, and recommendations will be made for enhancing criminal justice strategy programs.”

⁶¹ Further description from *NIJ Research Portfolio*, available December 2006 at: <http://nij.ncjrs.org/portfolio/> [Note, March 2007: This resource is no longer publicly available, it now appears to be password protected.]: “The Institute of Law and Justice (ILJ) will assemble influential participants from citizen review boards, community-based advocacy groups, public interest groups, big-city crime commissions, and other organizations to increase their understanding of NIJ's technology programs and to raise significant legal, social or political issues that may affect decisions regarding technology development and applications. After each of at least two such panels, ILJ will prepare a summary of the participants' reaction to selected technology presentations and a publication addressing the issues. Additionally, ILJ will add descriptions of new or emerging technologies on its web page.”

⁶² Further description from *NIJ Awards in Fiscal Year 1994*: “This project will establish requirements for the use of aqueous foam as a means to combat violent behavior in a correctional environment, assess health and safety risks, and evaluate the effectiveness of this system.”

⁶³ Further description from *NIJ Awards in Fiscal Year 1994*: “Military and Federal less-than-lethal technologies and related policy issues will be analyzed for their applicability to criminal justice situations, and recommendations will be made for enhancing criminal justice strategy programs.”

⁶⁴ Further description from *NIJ Awards in Fiscal Year 1995*: “The project will design, establish, and implement a process for assisting in the transfer of less-than-lethal technologies into policing and correctional operations.”

⁶⁵ In the original contract from 1995 the title was: “Law Enforcement, Technology Transfer, and Policing Assessment”

⁶⁶ In the original contract from 1995 the title was: “Law Enforcement, Technology Transfer, and Policing Liability Assessment”

⁶⁷ Further description from *NIJ Awards in Fiscal Year 1996*: “A policy and technology assessment panel is reviewing law enforcement technologies that are the most promising in the short and long terms and that should be the focus of further development and adaptation.” In the original contract from 1996 the title was: “Law Enforcement Technology, Technology Transfer, Less-Than-Lethal Technology, and Policy Assessment”. The title in 1997 was: “Less-Than-Lethal Technology Policy Assessment Panel”

⁶⁸ Further description from *NIJ Awards in Fiscal Year 1997*: “This award is demonstrating the utility of ultra-low frequency sound as an incapacitation technology suitable for hostage rescue scenarios.”

⁶⁹ Further description from *NIJ Research Portfolio*, available December 2006 at: <http://nij.ncjrs.org/portfolio/> [Note, March 2007: This resource is no longer publicly available, it now appears to be password protected.]: “The Ring Airfoil Projectile (RAP) is a doughnut-shaped, rubber impact projectile that was developed over 20 years ago for use by the National Guard during riots. It is a nonlethal device used to deter a single individual at a stand-off range by producing a "sting" when employed. It was never used by the military. However, law enforcement practitioners observed that the RAP had potential law enforcement use as an alternative to existing rubber bullet and shotbag projectiles. It is non-lethal at the muzzle, even with a head impact. Because it is an airfoil, it has a

longer effective range than many other projectiles, up to 40 meters. The RAP was developed to be launched from an M-16A1 using a specially designed adapter and a blank rifle cartridge. Because the M-16A1 is not commonly used by law enforcement practitioners and is no longer in production, it is not a practical launcher for the RAP. NIJ has provided a grant to Guilford Engineering, Inc. to design and develop a stand-alone, throw-away launch device for the RAP and the addition of pepper powder to the cavities around the RAP. Status: A prototype hand-held launcher was demonstrated in April 1999. Guilford Engineering developed the techniques to place pepper powder in the cavities of the RAP. Using this configuration, Guilford Engineering recently demonstrated the delivery of a small "cloud" of pepper to a targeted subject hit with the RAP. In the spring of 2001, the RAP was demonstrated successfully at the Mock Prison Riot."

⁷⁰ Further description from *NIJ Research Portfolio*, available December 2006 at:

<http://nij.ncjrs.org/portfolio/> [Note, March 2007: This resource is no longer publicly available, it now appears to be password protected.]: "Law enforcement agencies as well as military agencies are relying on nonlethal, blunt impact projectile technology to diffuse potentially life threatening situations without the use of lethal force. However, a standardized method for testing these nonlethal devices for level of injury has not yet been established. Although the automobile industry has developed and validated biomechanical human surrogates, the impacts of nonlethal munitions are different in terms of velocity and mass. Automotive impacts entail a large mass at low velocity while nonlethal projectile munitions entail low mass, high velocity impacts. Thus a new biomechanical surrogate for nonlethal munitions needs to be developed to test for level of injury. This project will use cadaver testing to establish human responses to low mass, high velocity blunt impacts. A 3-ribbed chest structure will be modified to replicate the human response and then validated. Validation of the 3-ribbed chest structure will provide law enforcement agencies with the ability to test all nonlethal blunt impact projectiles for risk of injury."

⁷¹ Further description from *NIJ Research Portfolio*, available December 2006 at:

<http://nij.ncjrs.org/portfolio/> [Note, March 2007: This resource is no longer publicly available, it now appears to be password protected.]: "This evaluation is identifying the health effects of the prototype electric stun projectile ("sticky shocker") based on the developer's technical information and other studies."

⁷² Further description from *NIJ Research Portfolio*, available December 2006 at:

<http://nij.ncjrs.org/portfolio/> [Note, March 2007: This resource is no longer publicly available, it now appears to be password protected.]: "To conduct an evaluation of a hand held laser dazzler to determine its safety, effectiveness, and suitability for law enforcement operational testing."

⁷³ Further description from NIJ Awards in Fiscal Year 1999: "Researchers are studying the applicability of less-than-lethal technology in school settings to determine whether these operational approaches could make a significant and cost-effective contribution to the safety and security of U.S. schools."

⁷⁴ Further description from *NIJ Research Portfolio*, available December 2006 at:

<http://nij.ncjrs.org/portfolio/> [Note, March 2007: This resource is no longer publicly available, it now appears to be password protected.]: "In a current NIJ development program for the Ring Airfoil Projectile (RAP), NIJ is funding the development of a pepper powder that will be delivered for use on the RAP. Developing this powder will take considerable resources. Therefore, NIJ is interested in examining commercially available pepper powder for use on the RAP. However, the characterization and health effects of the commercially available powder is not available. In addition, if the commercially available pepper powder is safe, it is unknown whether it will be effective in the RAP delivery system because only a small amount of the powder will be dispersed in the facial area. This award supports a separate determination whether an existing, commercially available powder, DefTech (DTP), may potentially be utilized in lieu of developing a new powder formulation. The following Tasks are anticipated to fulfill the Program objective: 1) Preliminarily characterize the physical and chemical properties of the commercially available DTP; 2) Characterize various lots of DTP for Capsaicin and its derivatives. Determine composition ranges, activities and the deviations of various available lots; 3) Conduct preliminary in-vivo testing to ascertain the projected safety of DTP, at the dosage levels anticipated by the RAP delivery system model." In the original 1999 contract the title was: "Preliminary Evaluation of Technology to Deliver Pepper Spray via a Ring Airfoil Projectile."

⁷⁵ National Institute of Justice (1999) *National Institute of Justice 1998 Annual Report to Congress*. Washington, DC: Department of Justice, National Institute of Justice.

⁷⁶ Now called the Home Office Scientific Development Branch (HOSDB).

⁷⁷ *Partnerships with Other Countries*, National Institute of Justice web site. Available March 2007 at: <http://www.ojp.usdoj.gov/nij/international/programs/partnerships.html>

- ⁷⁸ Northern Ireland Office (2001) *Patten Report Recommendations 69 and 70 Relating to Public Order Equipment: A Paper prepared by the Steering Group led by the Northern Ireland Office*. Belfast: Northern Ireland Office.
- ⁷⁹ *Partnerships with Other Countries*, National Institute of Justice web site. Available March 2007 at: <http://www.ojp.usdoj.gov/nij/international/programs/partnerships.html>
- ⁸⁰ Canadian Police Research Centre (1998) *Annual Report 1997*. Ottawa: Canadian Police Research Centre
- ⁸¹ National Institute of Justice (1997) *NIJ Annual Report to Congress 1996*. Washington, DC: Department of Justice, National Institute of Justice.
- ⁸² Burrows, C. (2001) Operationalizing Non-lethality: a Northern Ireland Perspective. *Medicine, Conflict and Survival*, pp. 260-271; Rappert, B. (2003) *Non-Lethal Weapons as Legitimizing Forces?: Technology, Politics and the Management of Conflict*. London: Frank Cass, pp. 139-143; Northern Ireland Office (2001) *Patten Report Recommendations 69 and 70 Relating to Public Order Equipment: A Paper prepared by the Steering Group led by the Northern Ireland Office*. Belfast: Northern Ireland Office.
- ⁸³ Independent Commission on Policing in Northern Ireland (1999) *A New Beginning: Policing in Northern Ireland. The Report of the Independent Commission on Policing for Northern Ireland*. Belfast: Independent Commission on Policing in Northern Ireland, pp. 54.
- ⁸⁴ *Ibid.*, p. 113.
- ⁸⁵ Kock, E. and Rix, B. (1996) A review of police trials of the CS aerosol incapacitant. *Police Research Series*. London: Home Office; Rappert, B. (2003) *Non-Lethal Weapons as Legitimizing Forces?: Technology, Politics and the Management of Conflict*. London: Frank Cass, pp. 175-201.
- ⁸⁶ Lewer, N. and Schofield, S. (1997) *Non-Lethal Weapons. A Fatal Attraction?* London: Zed Books, p. 34.
- ⁸⁷ *Ibid.*; Dando, M. (1996) *A New Form of Warfare: The Rise of Non-Lethal Weapons*. London: Brassey's, pp. 23-26.
- ⁸⁸ Morris, C. and Morris, J. (1991) *Nonlethality: A Global Strategy*. Washington, DC: US Global Strategy Council, p. 1.
- ⁸⁹ Wolfowitz, P. (1991) *Memorandum for the Secretary of Defense, Deputy Secretary of Defense. Do we Need a Nonlethal Defense Initiative?* Washington, DC: Department of Defense. Wolfowitz memorandum 1991
- ⁹⁰ Lovelace, D. and Metz, S. (1998) Nonlethality and American Land Power: Strategic Context and Operational Concepts. Carlisle: Strategic Studies Institute, US Army War College, p. 2.
- ⁹¹ Lewer, N. and Schofield, S. (1997) *Non-Lethal Weapons. A Fatal Attraction?* London: Zed Books, pp. 17-20.
- ⁹² Mazarr, M. (1993) *The Military Technical Revolution: A Structural Framework. Final Report of the CSIS Study Group on the MTR*. Washington, DC: Center for Strategic and International Studies, p. 43.
- ⁹³ Dando, M. (1996) *A New Form of Warfare: The Rise of Non-Lethal Weapons*. London: Brassey's, pp. 24-25; Kokoski, R. (1994) Non-lethal weapons: a case study of new technology developments. In: Stockholm International Peace Research Institute (SIPRI) (1994) *Sipri Yearbook 1994*. Oxford: Oxford University Press, pp. 367-386; Lewer, N. and Schofield, S. (1997) *Non-Lethal Weapons. A Fatal Attraction?* London: Zed Books, p. 34.
- ⁹⁴ Alexander, J. (1992) *Rethinking National Security Requirements & The Need for Non-Lethal Weapons Options*. Submitted to President-Elect Clinton's Transition Team. LA-UR-92-3773. Los Alamos: Los Alamos National Laboratory. *A prior version of this paper described the programme managed by Alexander as 'Disabling Technologies'. This has now been corrected to read 'Non-Lethal Defense'.*
- ⁹⁵ Alexander, J. (1989) Antimateriel Technology. *Military Review*, Vol. 69, No. 10, October, pp. 29-41.
- ⁹⁶ Alexander, J. (1992) *Rethinking National Security Requirements & The Need for Non-Lethal Weapons Options*. Submitted to President-Elect Clinton's Transition Team. LA-UR-92-3773. Los Alamos: Los Alamos National Laboratory.
- ⁹⁷ Council on Foreign Relations (1995) *Non-Lethal Technologies: Military Options and Implications. Report of an Independent Task Force*. New York: Council on Foreign Relations.
- ⁹⁸ Lewer, N. and Schofield, S. (1997) *Non-Lethal Weapons. A Fatal Attraction?* London: Zed Books, p. 33.
- ⁹⁹ *Ibid.*, p. 42.
- ¹⁰⁰ National Research Council (2003) *An Assessment of Non-Lethal Weapons Science and Technology*. Washington, DC: National Academies Press, pp. 63-64.

- ¹⁰¹ Army Armament Research, Development and Engineering Center (ARDEC) (1992) ARDEC exploring less-than-lethal munitions; to give Army greater flexibility in future conflicts. *ARDEC News Release*, 9 October 1992.
- ¹⁰² Ibid.; Tapscott, M. and Atwal, K. (1993) New Weapons That Win Without Killing on DOD's Horizon. *Defense Electronics*, February 1993, pp. 41-46.
- ¹⁰³ Harvard-Sussex Program (1992) *Chemical Weapons Convention Bulletin*. Issue No. 18, December 1992, p. 12.
- ¹⁰⁴ US Army (1996) *Concept for Nonlethal Capabilities in Army Operations*, TRADOC Pamphlet 525-73. Fort Monroe: Training and Doctrine Command (TRADOC).
- ¹⁰⁵ Army Armament Research, Development and Engineering Center (ARDEC) (1992) ARDEC exploring less-than-lethal munitions; to give Army greater flexibility in future conflicts. *ARDEC News Release*, 9 October 1992. Anti-materiel weapons projects included research with Los Alamos National Laboratory (LANL) on optical munitions to degrade sensors, high-power microwave (HPM) projectiles to destroy electronic equipment, and solid-state lasers.
- ¹⁰⁶ Lewer, N. and Schofield, S. (1997) *Non-Lethal Weapons. A Fatal Attraction?* London: Zed Books, p. 42.
- ¹⁰⁷ Thomas, M. (1998) *Non-Lethal Weaponry: A Framework for Future Integration*. Air Command and Staff College, Air University, Maxwell Air Force Base, Alabama, April 1998, p. 7.
- ¹⁰⁸ Advanced Research Projects Agency (ARPA) (1995) Limited Effects Technologies (LET) SOL BAA 95-28. *Commerce Business Daily*, 2 May 1995. Available March 2007 at: [http://www.fbodaily.com/cbd/archive/1995/05\(May\)/02-May-1995/Asol001.htm](http://www.fbodaily.com/cbd/archive/1995/05(May)/02-May-1995/Asol001.htm)
- ¹⁰⁹ Lorenz, F. (1996) Non-Lethal Force: The Slippery Slope to War? *Parameters*, Autumn 1996, pp. 52-62.
- ¹¹⁰ National Institute of Justice (1997) *Department of Justice and Department of Defense Joint Technology Program: Second Anniversary Report*, NCJ 164268. Washington DC: Department of Justice, National Institute of Justice.
- ¹¹¹ Ibid.
- ¹¹² Dando, M. (1996) *A New Form of Warfare: The Rise of Non-Lethal Weapons*. London: Brassey's, pp. 1-8.
- ¹¹³ National Research Council (2003) *An Assessment of Non-Lethal Weapons Science and Technology*. Washington, DC: National Academies Press, p. 53; Council on Foreign Relations (1995) *Non-Lethal Technologies: Military Options and Implications. Report of an Independent Task Force*. New York: Council on Foreign Relations.
- ¹¹⁴ National Research Council (2003) *An Assessment of Non-Lethal Weapons Science and Technology*. Washington, DC: National Academies Press, p. 63.
- ¹¹⁵ Lorenz, F. (1995) "Less-Lethal" Force in Operation United Shield. *Marine Corps Gazette*, September 1995, pp. 69-77.
- ¹¹⁶ Ireland, R. (1997) Tactical deployments of laser systems into low-intensity conflicts. *Proceedings of SPIE*, Vol. 2934, p. 70-74.
- ¹¹⁷ Ibid.
- ¹¹⁸ National Research Council (2003) *An Assessment of Non-Lethal Weapons Science and Technology*. Washington, DC: National Academies Press, p. 15.
- ¹¹⁹ Harvard-Sussex Program (1992) *Chemical Weapons Convention Bulletin*. Issue No. 22, December 1993, p. 25.
- ¹²⁰ Lewer, N. and Schofield, S. (1997) *Non-Lethal Weapons. A Fatal Attraction?* London: Zed Books, p. 36.
- ¹²¹ Ibid., p. 36 & p. 46; Black, S. (1993) *Non-Lethal Weapons Systems: The potential impact of new technologies on Low Intensity Conflicts*. Ridgeway Viewpoints, Matthew B. Ridgeway Center for International Security Studies, No. 93-9, p. 4.
- ¹²² Council on Foreign Relations (1995) *Non-Lethal Technologies: Military Options and Implications. Report of an Independent Task Force*. New York: Council on Foreign Relations.; Lewer, N. and Schofield, S. (1997) *Non-Lethal Weapons. A Fatal Attraction?* London: Zed Books, p. 35.
- ¹²³ Swett, C. (1994) Draft Policy for Non-Lethal Weapons. Washington, DC: Office of the Assistant Secretary of Defense, Special Operations/Low Intensity Conflict, Policy Planning. Cited in: Bunker, R. (ed) (1997) *Nonlethal Weapons: Terms and References*. USAF Institute for National Security Studies, Occasional Paper 15, USAF Academy Colorado.
- ¹²⁴ National Research Council (2003) *An Assessment of Non-Lethal Weapons Science and Technology*. Washington, DC: National Academies Press, p. 69.

- ¹²⁵ Council on Foreign Relations (1995) *Non-Lethal Technologies: Military Options and Implications. Report of an Independent Task Force*. New York: Council on Foreign Relations.
- ¹²⁶ US Department of Defense (1996) *Policy for Non-Lethal Weapons*, Directive 3000.3, 9 July 1996. Washington, DC: Office of the Assistant Secretary of Defense, Special Operations/Low Intensity Conflict.
- ¹²⁷ *Ibid.*
- ¹²⁸ *Ibid.*
- ¹²⁹ *Ibid.*
- ¹³⁰ Coates, J. (1970) *Nonlethal and Nondestructive Combat in Cities Overseas*. Paper P-569, Arlington VA: for Defense Analyses, Science and Technology Division.
- ¹³¹ For further discussion of the organisational structure of the JNLWP see: Feakin, T. (2005) *Non-lethal weapons: technology for lowering casualties?* Ph.D. thesis, Department of Peace Studies, University of Bradford; The Memorandum of Agreement (MOA) was updated in 1999.
- ¹³² National Research Council (2003) *An Assessment of Non-Lethal Weapons Science and Technology*. Washington, DC: National Academies Press, p. 41.
- ¹³³ Prioritisation as of Autumn 1998: Alexander, J. (1999) *Future War: Non-Lethal Weapons in Twenty-First-Century Warfare*. New York: St. Martin's. Appendix C, pp. 226-227; Joint Non-Lethal Weapons Directorate (1998) *Joint Non-Lethal Weapons Program (JNLWP) Annual Report 1997*. Quantico: Joint Non-Lethal Weapons Directorate; Joint Non-Lethal Weapons Directorate (2000) *Joint Non-Lethal Weapons Program (JNLWP) Annual Report 1999*. Quantico: Joint Non-Lethal Weapons Directorate; National Research Council (2003) *An Assessment of Non-Lethal Weapons Science and Technology*. Washington, DC: National Academies Press; Feakin, T. (2005) *Non-lethal weapons: technology for lowering casualties?* Ph.D. thesis, Department of Peace Studies, University of Bradford.
- ¹³⁴ Garwin, R. (1999) *Nonlethal Technologies: Progress and Prospects. Report of an Independent Task Force*. New York: Council on Foreign Relations; (Many of these were anti-materiel "information and communications warfare" programmes that are not addressed in this thesis.)
- ¹³⁵ Joint Non-Lethal Weapons Directorate (1998) *Joint Non-Lethal Weapons Program (JNLWP) Annual Report 1997*. Quantico: Joint Non-Lethal Weapons Directorate.
- ¹³⁶ Joint Non-Lethal Weapons Directorate (2000) *Joint Non-Lethal Weapons Program (JNLWP) Annual Report 1999*. Quantico: Joint Non-Lethal Weapons Directorate.
- ¹³⁷ *Ibid.*
- ¹³⁸ Beason, D. (2005) *The E-Bomb. How America's New Directed Energy Weapons will Change the Way Future Wars Will be Fought*. Cambridge: Da Capo Press, p. 119.
- ¹³⁹ The prototype Laser Dazzler has been developed by LE Systems with funding from the DARPA administered joint DOJ-DOD initiative on dual-use technologies. The prototype Saber 203 Laser Illuminator had been developed by the Air Force Research Laboratory (AFRL).
- ¹⁴⁰ National Research Council (2003) *An Assessment of Non-Lethal Weapons Science and Technology*. Washington, DC: National Academies Press, p. 58; Also see web site of the Emerald Express 99-1 Small Wars Conference, May 1999, available March 2007 at: <http://www.smallwars.quantico.usmc.mil/programs/EE/99-1.asp>
- ¹⁴¹ National Research Council (2003) *An Assessment of Non-Lethal Weapons Science and Technology*. Washington, DC: National Academies Press, p. 63-64.
- ¹⁴² Perry Robinson, J. (2003) *Disabling chemical weapons: a documented chronology of events, 1945-2003*, 1 November 2003 (unpublished).
- ¹⁴³ Joint Non-Lethal Weapons Directorate (1998) *Joint Non-Lethal Weapons Program (JNLWP) Annual Report 1997*. Quantico: Joint Non-Lethal Weapons Directorate.
- ¹⁴⁴ National Research Council (2003) *An Assessment of Non-Lethal Weapons Science and Technology*. Washington, DC: National Academies Press, p. 126.
- ¹⁴⁵ Marine Corps (1998) *Joint Concept for Non-Lethal Weapons*, Commandant of the Marine Corps, 5 January 1998.
- ¹⁴⁶ National Research Council (2003) *An Assessment of Non-Lethal Weapons Science and Technology*. Washington, DC: National Academies Press, p. 13.
- ¹⁴⁷ Department of Defense (1999) *FY 2000 RDT&E Budget Item Justification Sheet, 0603851M Non-Lethal Warfare DEM/VAL*. February 1999.
- ¹⁴⁸ *Ibid.*
- ¹⁴⁹ Department of Defense (1999) *FY 2000 RDT&E Budget Item Justification Sheet, 0603605F Advanced Weapons Technology*. February 1999.
- ¹⁵⁰ Department of Defense (1999) *FY 2000 RDT&E Budget Item Justification Sheet, 0602202F Human Effectiveness Applied Research*. February 1999.

- ¹⁵¹ Department of Defense (1999) *FY 2000 RDT&E Budget Item Justification Sheet, 0603228D8Z Physical Security Equipment*. February 1999.
- ¹⁵² Marine Corps System Command (1998) Research and Development for Non-Lethal Technologies SOL BAA-98-R-0016. *Commerce Business Daily*, 12 May 1998. Available March 2007 at: [http://www.fbodaily.com/cbd/archive/1998/05\(May\)/12-May-1998/Asol011.htm](http://www.fbodaily.com/cbd/archive/1998/05(May)/12-May-1998/Asol011.htm)
- ¹⁵³ Joint Non-Lethal Weapons Directorate (2000) *Joint Non-Lethal Weapons Program (JNLWP) Annual Report 1999*. Quantico: Joint Non-Lethal Weapons Directorate; Joint Non-Lethal Weapons Directorate (1998) *Joint NLW Directorate News*, Vol. 2, No.1, November 1998; Joint Non-Lethal Weapons Directorate (1999) *Joint Non Lethal Weapons Program News*, Vol. 2, No. 2, February 1999.
- ¹⁵⁴ Feakin, T. (2005) *Non-lethal weapons: technology for lowering casualties?* Ph.D. thesis, Department of Peace Studies, University of Bradford, pp. 162-166.
- ¹⁵⁵ Joint Non-Lethal Weapons Directorate (1998) *Joint NLW Directorate News*, Vol. 1, No.4, February 1998.
- ¹⁵⁶ Brill, A. (2001) The MCRU/Penn State Connection. *Sea Power*, April 2001.
- ¹⁵⁷ Shwaery, G. (2002) JNLWD (Joint Non-lethal Weapons Directorate) and NTIC (Non-lethal Technology Innovation Center) Missions. *Presentation to the National Defense Industrial Association (NDIA) conference, Non-Lethal Defense V: Non-Lethal Weapons: Now, More Than Ever, 26-28 March 2002*.
- ¹⁵⁸ *Ibid.*; Joint Non-Lethal Weapons Directorate (2000) *Joint Non-Lethal Weapons Program (JNLWP) Annual Report 1999*. Quantico: Joint Non-Lethal Weapons Directorate.
- ¹⁵⁹ Feakin, T. (2005) *Non-lethal weapons: technology for lowering casualties?* Ph.D. thesis, Department of Peace Studies, University of Bradford, p. 165.
- ¹⁶⁰ Allison, G, Kelley, P. and Garwin, R. (2004). *Nonlethal Weapons and Capabilities. Report of an Independent Task Force*. New York: Council on Foreign Relations, p. 16. – The FY 1999 figure had been significantly more than the \$22.6 million requested due to additional funds assigned by the US Congress.
- ¹⁶¹ National Research Council (2003) *An Assessment of Non-Lethal Weapons Science and Technology*. Washington, DC: National Academies Press, p. 70-71.
- ¹⁶² Garwin, R. (1999) *Nonlethal Technologies: Progress and Prospects. Report of an Independent Task Force*. New York: Council on Foreign Relations.
- ¹⁶³ *Ibid.*
- ¹⁶⁴ Feakin, T. (2005) *Non-lethal weapons: technology for lowering casualties?* Ph.D. thesis, Department of Peace Studies, University of Bradford, pp. 168-175.
- ¹⁶⁵ NATO (2006) *The Human Effects of Non-Lethal Technologies. The Final Report of NATO RTO HFM-073*. Brussels: NATO, Research and Technology Organisation, Chapter 1.
- ¹⁶⁶ Parent, C. (1995) Methods for deterring enemy aircraft eyed. *Inside the Pentagon*, 27 July 1995.
- ¹⁶⁷ NATO (1997) *Minimizing Collateral Damage during Peace Support Operations. Volume 1: Executive Summary. AGARD Advisory Report 347, Aerospace Applications Study 43*. Brussels: NATO, Advisory Group for Aerospace Research & Development (AGARD).
- ¹⁶⁸ Lewer, N. (2001) *Bradford Non-Lethal Weapons Research Project, Research Report No. 1*. Bradford: University of Bradford, Department of Peace Studies.
- ¹⁶⁹ *Ibid.*
- ¹⁷⁰ NATO (1997) *Minimizing Collateral Damage during Peace Support Operations. Volume 1: Executive Summary. AGARD Advisory Report 347, Aerospace Applications Study 43*. Brussels: NATO, Advisory Group for Aerospace Research & Development (AGARD).
- ¹⁷¹ NATO (1999) *NATO Policy on Non-Lethal Weapons*, 13 October 1999. Brussels: NATO.
- ¹⁷² Joint Non-Lethal Weapons Directorate (2000) *Joint Non-Lethal Weapons Program (JNLWP) Annual Report 1999*. Quantico: Joint Non-Lethal Weapons Directorate, p. 11.
- ¹⁷³ *Ibid.*
- ¹⁷⁴ House of Commons (1999) *House of Commons Hansard Written Answers for 10 Apr 2001 (pt 9)*. Available March 2007 at: <http://www.publications.parliament.uk/pa/cm200001/cmhansrd/vo010410/text/10410w09.htm>
- ¹⁷⁵ Joint Non-Lethal Weapons Directorate (2000) *Joint Non-Lethal Weapons Program (JNLWP) Annual Report 1999*. Quantico: Joint Non-Lethal Weapons Directorate, p. 11.
- ¹⁷⁶ Dando, M (Ed) (2000) *Non-Lethal Weapons: Technological and Operational Prospects*. London: Jane's Publishing.
- ¹⁷⁷ Rappert, B. (2003) *Non-Lethal Weapons as Legitimizing Forces?: Technology, Politics and the Management of Conflict*. London: Frank Cass, pp. 91-121.

- ¹⁷⁸ Pilant, L. (1993) Less-than-Lethal Weapons: New Solutions for Law Enforcement. *Science and Technology*, Washington, DC: International Association of Chiefs of Police, December 1993; Seaskate, Inc. (1998) *The Evolution and Development of Police Technology*. A Technical Report prepared for The National Committee on Criminal Justice Technology, National Institute of Justice, Grant 95-IJ-CX-K001(S-3). Washington, DC: Department of Justice, National Institute of Justice, p. 43.
- ¹⁷⁹ Lee, R., Yolton, R. and Janin, M. (2006) *Personal Defense Sprays: Effects and Management of Ocular and Systemic Exposure*. College of Optometry Continuing Education, Pacific University. Available March 2007 at: <http://www.opt.pacificu.edu/ce/catalog/13541-SD/pepper.html>. This is a republished version of the 1996 paper: Lee, R., Yolton, R., Yolton, D., Schnider, C, and Janin, ML. (1996) Personal Defense Sprays: Effects and Management of Exposure. *Journal of the American Optometry Association*. Vol. 67, No. 9, pp. 548-560.
- ¹⁸⁰ *Ibid.*; Rappert, B. (2003) *Non-Lethal Weapons as Legitimizing Forces?: Technology, Politics and the Management of Conflict*. London: Frank Cass, pp. 91-121.
- ¹⁸¹ Seaskate, Inc. (1998) *The Evolution and Development of Police Technology*. A Technical Report prepared for The National Committee on Criminal Justice Technology, National Institute of Justice, Grant 95-IJ-CX-K001(S-3). Washington, DC: Department of Justice, National Institute of Justice, p. 43.
- ¹⁸² Rappert, B. (2003) *Non-Lethal Weapons as Legitimizing Forces?: Technology, Politics and the Management of Conflict*. London: Frank Cass, pp. 91-121.
- ¹⁸³ *Ibid.*, pp. 102-113.
- ¹⁸⁴ *Ibid.*, p. 104.
- ¹⁸⁵ *Ibid.*, pp. 107-108; Zamorra, J. (1996) Pepper spray study is tainted. *The Examiner*, 20 May 1996.
- ¹⁸⁶ Rappert, B. (2003) *Non-Lethal Weapons as Legitimizing Forces?: Technology, Politics and the Management of Conflict*. London: Frank Cass, p. 104
- ¹⁸⁷ Aerospace Corp. (2001) *Final Report. National Law Enforcement and Corrections Technology Center-Western Region. Grant Number 96-MU-MU006*, September 2001, p. 17-18; Stockholm International Peace Research Institute (SIPRI) (1973) *The Problem of Chemical and Biological Warfare. Volume II: CB Weapons Today*. Stockholm: Almqvist & Wiksell, p. 306.
- ¹⁸⁸ Olajos, E. and Salem, H. (2001) Riot Control Agents: Pharmacology, Toxicology, Biochemistry and Chemistry. *Journal of Applied Toxicology*, Vol. 21, pp. 355-391.
- ¹⁸⁹ Air Taser changed its' name to Taser International in 1998.
- ¹⁹⁰ Donnelly, T., Douse, K., and Gardner, M. (2002) *PSDB Evaluation of Taser Devices. Publication No 9/02*. London: Home Office, Police Scientific Development Branch (PSDB), pp. 43-44; Laur, D. (1999) *Independent Evaluation Report of TASER and Air TASER Conducted Energy Weapons*. Victoria: Victoria Police Department. Available March 2007 at: http://www.taser.com/law/product_info/support/06.htm; *Taser International Corporate Background* web site, available March 2007 at: <http://www.taser.com/pages/pr/corpbackground.html>
- ¹⁹¹ Smith, R. (1996) Reducing violence: an analytical and technical approach. *Proceedings of SPIE*, Vol. 2934, pp. 27-36.
- ¹⁹² *Ibid.*
- ¹⁹³ Greenberg, I. (1999) Prodding Car Thieves to Reform. *Wired News*, 23 July 1998.
- ¹⁹⁴ Donnelly, T., Douse, K., and Gardner, M. (2002) *PSDB Evaluation of Taser Devices. Publication No 9/02*. London: Home Office, Police Scientific Development Branch (PSDB), pp. 43-44.
- ¹⁹⁵ Laur, D. (2000) Taser Technology Research Paper, Technical Report TR-01-2000. Ottawa: Canadian Police Research Service
- ¹⁹⁶ Laur, D. (1999) *Independent Evaluation Report of TASER and Air TASER Conducted Energy Weapons*. Victoria: Victoria Police Department; The company called this development effort 'Project Stealth': *Taser International Corporate Background* web site, available March 2007 at: <http://www.taser.com/pages/pr/corpbackground.html>
- ¹⁹⁷ *Taser International Corporate Background* web site, available March 2007 at: <http://www.taser.com/pages/pr/corpbackground.html>
- ¹⁹⁸ Laur, D. (1999) *Independent Evaluation Report of TASER and Air TASER Conducted Energy Weapons*. Victoria: Victoria Police Department.
- ¹⁹⁹ McNulty, J. (2000) Non-Lethal, Taser Remote Controlled Sentinel Weapon. *Presentation to the National Defense Industrial Association (NDIA) conference, Non-Lethal Defense IV, 20-22 March 2000*.
- ²⁰⁰ Vasel, E., Bryars, J., Coakley, P., Mallon, C., Millard, J., Niederhaus, G., and Nunan, S. (1997) Sticky Shocker. *Proceedings of SPIE*, Vol. 2934, pp. 10-14.

- ²⁰¹ Kenny, J., Murray, W., Sebastianelli, W., Kraemer, W., Fish, R., Mauger, D., and Jones, T. (1999) *Human Effects Advisory Panel. Report of Findings: Sticky Shocker Assessment*. Pennsylvania State University, Applied Research Laboratory.
- ²⁰² Amnesty International (1997) *Arming the Torturers. Electro-shock Torture and the Spread of Stun Technology*. ACT 40/001/1997.
- ²⁰³ Flatau, A. (2000) Ring Airfoil Grenade: A Less-Than Lethal Configuration for the Delivery of Selected Chemical Agents. *Presentation to the National Defense Industrial Association (NDIA) conference, Non-Lethal Defense IV, 20-22 March 2000*; Aerospace Corp. (2001) *Final Report. National Law Enforcement and Corrections Technology Center-Western Region. Grant Number 96-MU-MU006*, September 2001, p. 17.
- ²⁰⁴ Burrows, C. (2001) Operationalizing Non-lethality: a Northern Ireland Perspective. *Medicine, Conflict and Survival*, pp. 260-271
- ²⁰⁵ *United States Patent No. 4,202,209*, 13 May 1980.
- ²⁰⁶ Scott, S. (1997) Sticky Foam as a Less-Than-Lethal Technology. *Proceedings of SPIE*, Vol. 2934, pp. 131-133.
- ²⁰⁷ National Research Council (2003) *An Assessment of Non-Lethal Weapons Science and Technology*. Washington, DC: National Academies Press, p. 127.
- ²⁰⁸ Scott, S. (1997) Sticky Foam as a Less-Than-Lethal Technology. *Proceedings of SPIE*, Vol. 2934, pp. 131-133.
- ²⁰⁹ Goolsby, T. (1997) Aqueous Foam as a Less-Than-Lethal Technology for Prison Applications *Proceedings of SPIE*, Vol. 2934, pp. 86-95.
- ²¹⁰ Mathis, R. (2000) Non-Lethal Applications of Slippery Substances. *Presentation to the National Defense Industrial Association (NDIA) conference, Non-Lethal Defense IV, 20-22 March 2000*; Collins, K. (2000) Non-Lethal Applications of Slippery Substances. *Presentation to the National Defense Industrial Association (NDIA) conference, Non-Lethal Defense IV, 20-22 March 2000*.
- ²¹¹ US Army (1997) *Odorous Substances*. Research Proposal, Army Edgewood Research, Development, and Engineering Center (ERDEC), July 1997. Available March 2007 at: <http://www.sunshine-project.org/incapacitants/jnlwdpdf/edgesmells.pdf>
- ²¹² Bickford, L. (2000) Odorous Substances for Non-Lethal Applications. *Presentation to the National Defense Industrial Association (NDIA) conference, Non-Lethal Defense IV, 20-22 March 2000*.
- ²¹³ Dando, M. (1996) *A New Form of Warfare: The Rise of Non-Lethal Weapons*. London: Brassey's, pp. 136-168.
- ²¹⁴ Andresen, B. and Grant, P. (1997) *Dose Safety Margin Enhancement for Chemical Incapacitation and Less-than-Lethal Targeting, NIJ Final Report and Recommendations*. Forensic Science Center R-Division, Nonproliferation, Arms Control, and International Security Directorate, Lawrence Livermore National Laboratory. January 1997
- ²¹⁵ Joint Non-Lethal Weapons Directorate (2000) *Joint Non-Lethal Weapons Program (JNLWP) Annual Report 1999*. Quantico: Joint Non-Lethal Weapons Directorate.
- ²¹⁶ Moore, H. (2000) Aversive Audible Acoustic Devices. *Presentation to the National Defense Industrial Association (NDIA) conference, Non-Lethal Defense IV, 20-22 March 2000*; Boesch, H. and Reiff, C. (2000) *A Prototype High-Intensity Infrasonic Test Chamber (HILF 1)*. *Presentation to the National Defense Industrial Association (NDIA) conference, Non-Lethal Defense IV, 20-22 March 2000*.
- ²¹⁷ Wes, J. (2000) Man-tossable Acoustic Distraction Device. *Presentation to the National Defense Industrial Association (NDIA) conference, Non-Lethal Defense IV, 20-22 March 2000*.
- ²¹⁸ Knoth, A. (1994) Disabling Technologies. A Critical Assessment. *International Defense Review*, No. 7, July 1994, pp. 33-39.
- ²¹⁹ Adler, D. (2000) Anti-Personnel Laser Illuminators: Effectiveness Testing of HALT and Dissuader. *Presentation to the National Defense Industrial Association (NDIA) conference, Non-Lethal Defense IV, 20-22 March 2000*; National Research Council (2003) *An Assessment of Non-Lethal Weapons Science and Technology*. Washington, DC: National Academies Press, p. 28.
- ²²⁰ Human Rights Watch (1995) *Blinding Laser Weapons: The Need to Ban a Cruel and Inhumane Weapon*. New York: Human Rights Watch, Vol. 7, No. 1, September 1995, p. 23.
- ²²¹ Adler, D. (2000) Anti-Personnel Laser Illuminators: Effectiveness Testing of HALT and Dissuader. *Presentation to the National Defense Industrial Association (NDIA) conference, Non-Lethal Defense IV, 20-22 March 2000*.
- ²²² Hewish, M. (2000) Beam weapons revolution – Directed-energy weapons point the way for battlefield technology. *International Defense Review*, 1 August 2000. HPM weapons to degrade electronics were presented as “non-lethal” anti-materiel weapons.

- ²²³ Abaie, M. (1998) Unmanned Aerial Vehicle (UAV) Non-Lethal (NL) Payload Delivery System. *Presentation to the National Defense Industrial Association (NDIA) conference, Non-Lethal Defense III, 25-26 February 1998.*
- ²²⁴ Kelly, R. (2000) PepperBall Non-Lethal Weapon Compliance Technology. An Alternative to Lethal Force. *Presentation to the National Defense Industrial Association (NDIA) conference, Non-Lethal Defense IV, 20-22 March 2000.*
- ²²⁵ Doswald-Beck, L. (1996) New Protocol on Blinding Laser Weapons. *International Review of the Red Cross*, No. 312, pp. 272-299.
- ²²⁶ *Ibid.*
- ²²⁷ Human Rights Watch (1995) United States: US Blinding Laser Weapons. New York: Human Rights Watch, Vol. 7, No. 5, May 1995.
- US blinding lasers may 95 also paper in oct 95
- ²²⁸ Doswald-Beck, L. (1996) New Protocol on Blinding Laser Weapons. *International Review of the Red Cross*, No. 312, pp. 272-299; US Department of Defense (1995) DOD Announces Policy On Blinding Lasers. *DOD News Release*, No. 482-95, 1 September 1995.
- ²²⁹ United Nations (1995) *Additional Protocol to the Convention on Prohibitions or Restrictions on the Use of Certain Conventional Weapons which may be Deemed to be Excessively Injurious or to have Indiscriminate Effects. Article 1: Additional Protocol: Protocol on Blinding Laser Weapons (Protocol IV)*. CCW/CONF.I/7, 12 October 1995.
- ²³⁰ *Ibid.*
- ²³¹ Doswald-Beck, L. (1996) New Protocol on Blinding Laser Weapons. *International Review of the Red Cross*, No. 312, pp. 272-299.
- ²³² Human Rights Watch (1999) HRW Questions U.S. Laser Programs As Blinding Laser Weapon Ban Becomes International Law. *Human Rights Watch News Release*, 29 July 1998.
- ²³³ Stock, T. (1995) *History of the Negotiations on the CWC—short overview*. SIPRI-Saskatchewan-Frankfurt Research Group.
- ²³⁴ United Nations (1993) *Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on their Destruction*, 13 January 1993, Article I.
- ²³⁵ Perry Robinson, J. and Meselson, M. (1994) New Technologies and the Loophole in the Convention. *Chemical Weapons Convention Bulletin*, Issue No. 23, March 1994, pp. 1-2.
- ²³⁶ Dando, M. (1996) *A New Form of Warfare: The Rise of Non-Lethal Weapons*. London: Brassey's, p. 185.
- ²³⁷ United Nations (1993) *Convention on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on their Destruction*, 13 January 1993, Article II 7.
- ²³⁸ *Ibid.*, Article II 9(d).
- ²³⁹ Dando, M. (1996) *A New Form of Warfare: The Rise of Non-Lethal Weapons*. London: Brassey's, p. 185.
- ²⁴⁰ Perry Robinson, J. and Meselson, M. (1994) New Technologies and the Loophole in the Convention. *Chemical Weapons Convention Bulletin*, Issue No. 23, March 1994, pp. 1-2.
- ²⁴¹ US Navy (1997) *Preliminary Legal Review of Proposed Chemical-Based Nonlethal Weapons*. Department of the Navy, Office of the Judge Advocate General, International & Operational Law Division. Available March 2007 at: <http://www.sunshine-project.org/incapacitants/jnlwdpdf/jagchemi.pdf>
- ²⁴² *U.S. Senate's Executive Resolution on Ratification of the CWC, 105th Congress, 1st Session, S. Exec. Res. 75*. Available March 2007 at: http://www.fas.org/bwc/us_cwc_senate_resolution.htm
- ²⁴³ Fidler, D. (2005) The meaning of Moscow: "Non-lethal" weapons an international law in the early 21st century. *International Review of the Red Cross*, Vol. 87, No. 859, September 2005, pp. 525-552.
- ²⁴⁴ US Navy (1997) *Preliminary Legal Review of Proposed Chemical-Based Nonlethal Weapons*. Department of the Navy, Office of the Judge Advocate General, International & Operational Law Division.
- ²⁴⁵ *Ibid.*, pp. 21-22
- ²⁴⁶ United Nations (1997) *Convention on the Prohibition of the Use, Stockpiling, Production and Transfer of Anti-Personnel Mines and on their Destruction*, 18 September 1997.
- ²⁴⁷ Arms Control Association (2005) *The Ottawa Convention at a Glance*. Arms Control Association Fact Sheet, December 2005.
- ²⁴⁸ Joint Non-Lethal Weapons Directorate (1997) *Joint NLW Directorate News*, Vol. 1, No. 3, December 1997.
- ²⁴⁹ United Nations (1990) *Basic Principles on the Use of Force and Firearms by Law Enforcement Officials*. Geneva: Office of the United Nations High Commissioner for Human Rights.

²⁵⁰ *Ibid.*