



PATTEN REPORT RECOMMENDATIONS 69
AND 70 RELATING TO PUBLIC ORDER
EQUIPMENT:

**A Paper prepared by the Steering Group led by the
Northern Ireland Office**

April 2001



FOREWORD BY THE RT HON ADAM INGRAM MP JP

In June of last year the then Secretary of State for Northern Ireland established a UK-wide Steering Group to lead a research project to:

- establish whether a less potentially lethal alternative to the baton round is available; and
- review the public order equipment which is presently available or could be developed in order to expand the range of tactical options available to operational commanders.

Phase 1 of the project, detailed in the terms of reference given to the Group, was completed in February. I have now received a report from the Group describing the work that has been completed to date and setting out the work programme to be taken forward over the next eight months.

As the Government is aware of the interest that many in the wider community have in the outcome of this work, we decided that the report should be made public.

I commend this document as a report on work in progress. I will take a continuing, close interest in the next phase of the programme.

The Rt Hon Adam Ingram MP JP
Minister of State for Northern Ireland

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A. INTRODUCTION

1. The Report of the Independent Commission on Policing for Northern Ireland (the Patten Report), published in September 1999, contained recommendations relating to the use of public order equipment.
2. **Recommendation 69 stated that “An immediate and substantial investment should be made in a research programme to find an acceptable, effective and less potentially lethal alternative to the Plastic Baton Round (PBR).”**
3. **Recommendation 70 stated that “The police should 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/her disposal which might reduce reliance on, or defer resort to, the PBR.”**
4. In summer 2000, the then Secretary of State for Northern Ireland, having consulted with Cabinet colleagues and others, established a UK-wide Steering Group to lead a research project aimed at:
 - establishing whether a less potentially lethal alternative to the baton round is available; and
 - reviewing the public order equipment which is presently available or could be developed in order to expand the range of tactical options available to operational commanders.
5. The Group comprised representatives from Her Majesty's Inspectorate of Constabulary, the Home Office, the Association of Chief Police Officers, the Ministry of Defence, the Police Authority for Northern Ireland, the Police Scientific Development Branch (PSDB) of the Home Office and the RUC, and was chaired by the Northern Ireland Office. It was given the following Terms of Reference.

B. TERMS OF REFERENCE

Objective

To establish whether a less potentially lethal alternative to baton rounds is available; and to review the public order equipment which is presently available or could be developed in order to expand the range of tactical options available to operational commanders.

Task

In the light of the recommendations in the Patten Report for a research programme to find an acceptable, effective and less potentially lethal alternative to the Plastic Baton Round, and for the RUC to be equipped with a broader range of public order equipment, to provide advice to the Secretary of State for Northern Ireland in a report as follows:

Phase 1 (defining operational objectives and literature review)

Define the operational objective against which less potentially lethal weapons must be tested.

- Prepare a literature review of less potentially lethal weapons available or under research.
- Examine the literature review against the operational objective.

Phase 2 (evaluating the literature review, preparing business case and directing further research as necessary)

- Formulate proposals for further research on less potentially lethal weapons which would benefit from further research and which have the potential for successful transfer to the operational field, setting out the timings and the costs of that research.
- Prepare business case.

Phase 3 (research)

- As directed under Phase 2, conduct further research, evaluate performance and safety, and establish deployment costs.

Phase 4 (operational objectives and public order equipment)

- Define operational objectives for public order equipment.
- Prepare a report on the tactical deployment of a range of public order equipment in Northern Ireland, covering as wide a range of equipment as possible.

6. The Terms of Reference were notified to Mr Tom Constantine (Oversight Commissioner) and were subsequently published, in response to a Parliamentary Question, tabled in July 2000.

C. SUMMARY OF PHASE 1

7. The Steering Group has met five times since it was established in June 2000 and has focused on completing Phase I of the research project. Members of the Group had the opportunity to view public order operations at Drumcree and in Belfast in July 2000. There has also been a series of other meetings as well as the research commissioned. In particular, the Group has taken steps to ensure that its work is consistent with the approach being adopted by the Association of Chief Police Officers of England, Wales and Northern Ireland (ACPO). In addition, contact has been made with a range of other bodies with relevant expertise including, for example, the National Institute of Justice in America and Pennsylvania State University.

8. Phase I of the project was completed in mid-February 2001. It produced both a Framework Document and a Literature Review. The following document forms the basis of the Steering Group's Report at the end of Phase I and covers both these elements.

9. The Framework Document was prepared by the Steering Group to provide a framework for the project and to set out initial criteria against which potential alternative systems and tactical options could be judged. The Steering Group, in seeking to carry out a literature review, tasked PSDB with reviewing the currently available technologies and equipment that could potentially be employed in situations where a less lethal weapon is considered appropriate for use. This report is being made available to the ACPO Sub-Committee on Police Use of Firearms and the ACPO Sub-Committee on Public Order.

D. NEXT STEPS

10. The business of policing necessarily involves dealing with individuals and groups of people in a wide variety of situations. These will include routine patrolling as well as serious disorder and the requirements of the police, in terms of less lethal tactical options, may differ considerably from one scenario to another. For example, in one situation a water cannon might be an appropriate response, while in another hand-held personal defence incapacitant spray might be considered.

11. In order to evaluate equipment objectively, the policing needs must be translated into performance and technical specifications to provide measurable criteria against which to compare items of equipment. PSDB are currently formulating initial specifications that will be used to begin evaluation of characteristics such as accuracy, range, reliability and velocities. Work of this nature has also been carried out by other organisations for some equipment and wherever possible these data will be drawn on, once validated, to avoid duplication of effort.

12. The Steering Group has created a Project Board to take forward the work in a focused, time-bound manner. An experienced project manager, from outside Northern Ireland, has been appointed.

13. There are a number of strands to the second phase of the programme which is now beginning. They include:

- completing a needs analysis of the policing context in Northern Ireland;
- evaluating equipment that the Steering Group considers may have further potential;
- assessing the approaches adopted elsewhere in comparable jurisdictions;
- benchmarking with analogous bodies;
- undertaking or commissioning such further research as may be appropriate, in liaison with academic institutions, where this is helpful;
- analysing the views of interested parties;
- preparing business cases for the procurement or further development of items of equipment.

14. Account will also be taken of existing baton round technologies so that any developments that enable the injury potential to be reduced or controlled still further can be taken up during the lifetime of this project.

15. It is the intention to complete this by the end of October 2001, if at all possible. The work will be taken forward with urgency.

16. Where detailed evaluation is required, it would include a number of elements: an independent medical review of each option, thorough testing to support the more detailed medical review and an assessment of how each satisfies the more detailed individual elements of the specifications eg range, compatibility with other options, environment, ergonomic effectiveness etc. Prior to any operational deployment, field trials would need to be carried out under appropriate conditions to evaluate aspects of the equipment which cannot be measured in a non-operational environment.

E. THE FRAMEWORK DOCUMENT

Introduction

17. This document relates primarily to the work following up recommendation 69, rather than recommendation 70 of the Patten Report (see paragraphs 2 and 3 above) but the two are inter-related.

18. It should be noted that while this project stems directly from the report of the Independent Commission on Policing for Northern Ireland, there are UK-wide implications for the project. Account will therefore also be taken of the work being taken forward under the Association of Chief Police Officers (ACPO) aegis.

19. The purpose of this document is to provide a framework for the project, and to set out initial criteria against which potential alternative systems and tactical options can be judged. The criteria may need to be slightly modified to take account of further developments.

20. The terms of recommendation 69 require the group to address three specific areas – acceptability, effectiveness and lethality or minimum force.

Acceptability

21. The criteria for acceptability must be agreed within a UK framework and benchmarked against the legal requirements, as set out particularly in the Human Rights Act 1998.

22. There are three areas, closely inter-linked, under which acceptability should be considered. These are:

- human rights and legal requirements;
- ethical and cultural grounds; and
- medical issues.

23. The Human Rights Act 1998 incorporated the provisions of the European Convention on Human Rights into UK domestic law. Article 2 of the ECHR places an obligation on the State positively to promote the right to life. The provision and use of less lethal weapons and options provide a means of fulfilling that obligation, and protecting the lives of the public and police officers, in violent confrontations. However, cognisance must also be taken, in the selection of appropriate less lethal options, of other Rights, particularly Article 3 relating to the prohibition of torture, inhumane or degrading treatment.

24. Any alternative to the existing round must be benchmarked against ethical and cultural standards. The systems encompassed by the term ‘less potentially lethal’ could include chemical agents, impact devices, electrical and other sensory disorientation equipment (including those set out in the table on page 55 of the Patten Report).

25. Risk is an important factor. Independent medical assessment will be made of medical risk, supported and validated by scientific testing, data collection and analysis.

Effectiveness

26. Baton rounds are designed to provide a less than lethal option in dealing with threats of serious violence and provide an effective means by which rioters armed with petrol bombs or other weapons can be kept at a distance, contained or dispersed. They also provide a means of keeping at a safe distance those posing a serious threat to life which would otherwise require the interventions of officers at close quarters, potentially placing them at great risk.

27. Alternatives to the baton round must therefore be capable of meeting a number of operational requirements, including the following:

- creating and/or maintaining distance between the user and those against whom they are being used;
- containing a riotous crowd and preventing escalation or spread of violence;
- repelling individual attackers with potentially life threatening weapons;
- in certain circumstances, incapacitating temporarily those intent on violent attack;
- reducing serious risk of loss of life or serious injury or substantial and serious damage to property;
- dissuading repetition of attack;
- dispersal in a controlled manner of large groups of rioters.

It is accepted that these criteria will not apply uniformly to all potential alternative equipment.

28. In reaching a final judgement on the recommendation of any alternatives, the project will also need to include consideration of the following:

- accuracy
- ease of deployment and operation
- environment
- training
- costs
- authorisation for use.

Appropriate Use of Force

29. The Patten recommendation calls for a less potentially lethal alternative to the plastic baton round. While the use of baton rounds prior to 1989 resulted in a number of deaths, there have been no fatalities since. Moreover, the weapons systems used since 1994 have been of a significantly different design. However, as with all

applications of force, there remains a potential for unintended serious, and even fatal, injury. Alternatives should be shown to have the effect of further reducing the potential to cause death or serious/permanent injury, set against the benchmark of the current baton round system, and the operational use of previous baton rounds.

F. THE LITERATURE REVIEW

Introduction

30. Throughout this document reference is made to less lethal systems. This term has been deliberately chosen and needs to be used very carefully. There is a range of less lethal weapons and systems available. Implicit in all applications of force is the potential for injury, and indeed lethal, outcome. The design of the equipment and the way in which it is used can substantially reduce this risk. The extent to which the risk becomes acceptable very much depends on the situation in which the weapon or system is used. (For example, if less lethal weaponry is being deployed as an alternative to a conventional firearm, this represents a de-escalation of force.) In the past these options have been referred to as “non-lethal” or “less than lethal”. Both of these terms imply that death will not result, following the use of these weapons, but this is not always the case. The United States National Institute of Justice (see Acknowledgements) uses the following definition for this type of equipment:

"Devices or agents used to induce compliance with law enforcement personnel without substantial risk of permanent injury or death to the subject."

31. This definition provides a useful context in which to view the available options.

32. Two points should be made in relation to the rest of this document.

33. The performance data on commercially available products provided in this document are from manufacturers' data and have not yet been verified by a PSDB testing programme. It should also be stressed that little evidence is available of independent medical assessment for much of the commercially available equipment covered by this review.

Technologies available

34. Many different methods can be used to produce the effects required from less lethal **systems**. These required effects would range from incapacitation to simple dissuasion from entering an area. They can broadly be divided into the following categories:

- Chemical
- Diversion and Distraction
- Electrical
- Impact
- Mechanical

35. There are some types of equipment which do not obviously fit into the above categories. These tend to combine more than one method of incapacitation into one device. Examples of these are the Ring Airfoil Projectile (RAP), which combines chemical and impact methods, and the Sticky Shocker, which combines electrical and impact; they have been placed in the most appropriate section.

36. Some of the systems, especially impact rounds, offer the option of 'tagging' offenders with a dye or similar marker to facilitate later arrest. In general, it is unclear that, without unambiguous tagging and no possibility of cross contamination, such a system would be of value. Linkage with video evidence could lead to arrest, but tagging may be unnecessary, if video evidence is available. Tagging can also be 'virtual', such as the use of a spotlight to highlight troublemakers in a crowd, possibly as targets for other public order systems or for arrest. Spotlights are mentioned in the section on diversion and distraction devices.

37. Each category is expanded in the following sections and accompanied by a brief generic summary of varieties of weapons, systems or modes of delivery utilising that particular technology. Any pictures used are chosen to be representative of the type of equipment and are not intended to indicate a preference.

Chemical

38. There are a number of chemical agents available that have been used as crowd control devices or as close quarter personal incapacitant sprays. The most widely used world-wide are CS and OC. CN and CR are also used in places and PAVA is beginning to be used in some countries.

39. CS (o-chlorobenzylidene malononitrile) was first synthesised in 1928 by Corson and Stoughton and is a white crystalline solid, not a gas, as it is often called. CS was introduced in the UK in 1958 to replace CN as a riot control device, as it was believed to be more effective and safer than CN. Prior to the adoption of CS by the GB police in the form of a hand-held spray in 1996, consideration was given to a number of other chemical incapacitants. A brief summary of each of these is given below, along with the reasons for their rejection for use in the UK. CS is currently the only chemical incapacitant used by the GB police; this applies to all methods of dissemination, not just to hand-held sprays.

40. Oleoresin Capsicum (OC) is the oily extract (oleoresin) of the species *Capsicum* (peppers) and is a complex mixture of over one hundred volatile compounds. The active ingredients of OC, i.e. those components which cause the burning sensation and pain, are called capsaicinoids, the main one of which is called capsaicin. Capsaicin, and some other capsaicinoids, are used as topical treatments for painful conditions, as they selectively affect a part of the nervous system involved with pain sensations, resulting in the production of pain, with subsequent desensitisation to pain. The proportion of each of the capsaicinoids, and the total capsaicinoid content, of OC sprays varies between different manufacturers and between batches, as the composition differs, based on species of capsicum, time harvested and portion of the plant used. In the US, OC is not controlled by any regulatory organisations since it is a naturally occurring product. Although there has been much toxicological testing carried out on capsaicin over the years, this is not so for OC as a whole or for many of the other capsaicinoids. As a result of this lack of toxicological information on OC, it was not considered suitable for use in the UK.

41. PAVA (pelargonic acid vanillylamide), also commonly known as nonivamide, is a capsaicinoid which occurs naturally in OC and which is less pungent than capsaicin, although it is believed to work in the same way. In recent years, it has become available for use as an incapacitant spray and is produced synthetically for this purpose. PAVA is believed to have the following potential advantages over OC: it is a single compound, and therefore it would be easier to obtain all of the toxicological information necessary than would be the case for OC; also, as it is a single compound which is produced synthetically, it is of reproducible quality and pungency and not subject to the variations in strength and effectiveness which occur with OC products. At present, PAVA has gone through a number of toxicological tests, although as yet, not enough information is available to be able to recommend the use of PAVA in an incapacitant spray or other method of dissemination. These tests are, however, continuing and being monitored.

42. CN (chloroacetophenone) is another well known chemical incapacitant which is still used in some countries. CN is believed to have a greater toxicity than CS, although it is not as potent and would therefore require larger amounts to be used to achieve the same effects. In consequence, the margin of safety between incapacitating dose and lethal dose for CN is much less than that for CS and so it is not considered suitable for use in the UK.

43. CR (Dibenz (b.f.)-1:4-oxazepine), first synthesised in 1962, has also been considered for use as a chemical incapacitant. However, CR does not break down in water which would lead to problems with decontamination after use.

44. The method of delivery of chemical incapacitants differs depending on the target and the situation in which the devices are being used. These delivery methods can be split into three groups; a description of each follows.

Grenades and Projectiles



45. Grenades and projectiles disseminate the incapacitant either pyrotechnically as a powder or they may use a solvent to aid dispersal of the irritant contents. They are used either for crowd control or to fill a room or vehicle, the latter types usually also having barricade penetrating abilities. The chemical is released into a volume, the size of which varies depending on the method of dispersal and the quantity of incapacitant contained within the device. In some grenade devices, the grenade splits into a number of sections and each section discharges a quantity of irritant, thereby further increasing the range of the device.

46. Grenades can either be hand thrown or launched using 37/38mm gas guns, 40mm grenade launchers, or muzzle launchers. Other rounds use a 12-gauge shotgun for delivery. The grenades and projectiles can contain one individual chemical (see above) or a mixture of two together. Different rounds contain different amounts of chemical irritant. Pyrotechnically deployed CS was at one time used in Northern Ireland and is extensively used in Europe. Its effects and other details associated with its use are well documented.

47. Grenades are most often used for crowd control situations. Their range is approximately 25–40m when thrown by hand and between 50m and 300m when launched, depending on the type of launcher used. Some short-range devices are also available which are fired from 37/38mm gas guns and disperse their contents at ranges of approximately 10m. The grenades usually have a fuse delay time of between 0.7 and 2 seconds and emit their contents for a pre-set time, generally somewhere between 3 and 40 seconds. The contents are released in one of two ways: either the grenade bursts on impact with a surface, or the grenade has ports down the side or on the top and bottom and a carbon dioxide cartridge in the centre to force the contents from these ports.

48. Grenades are also available which combine a chemical irritant with a discharge of sound and light and/or a number of small rubber balls or pellets. In these cases, there is a combination of chemical effects with distraction/disorientation and/or blunt impact effects.

49. 12 gauge rounds are often used as barricade penetrating rounds to allow their contents to be dispersed into a barricaded room or vehicle, although they can also be used for crowd control situations. For 12-gauge shotgun launched devices, the range is between 30–80m.

Personal Incapacitant Sprays



Various Types of Sprays

50. Chemicals other than CS are used in some other countries, although CS is still widely used. Either an individual chemical is used in a spray, or two may be mixed together. An ultraviolet marking dye is also used in a number of products along with the irritants. The types of spray used vary from a jet stream to a mist spray design. Jet streams are the most discriminating and have a better range than mist sprays. They are also less affected by cross winds and produce larger particles which results in less chance of inhalation deep into the lungs. The sprays used generally have a range of 2–4m and contain between 5 and 40 one-second bursts of spray. Some larger canisters are also available with a range of 4–7m.

51. CS, in the form of a hand-held spray, was first introduced into the GB police service in 1996 and is now used by most police forces within mainland Britain. The GB sprays consist of a 5% solution of CS with the solvent MIBK (methyl isobutyl ketone). The range of these devices is approximately 3m but the jet-type design ensures that the sprays are discriminate. Much work has been done on these sprays already and a technical specification was produced in 1997 to reflect the operational requirement of the police.

Olfactory Agents

52. Research is currently underway in the US on olfactory agents. An extremely pungent smell is contained in a canister that bursts on impact. Such smells or odours have been shown to cause feelings of alarm in people as well as the obvious impulse to vacate the area because the smell is so bad. Targeting a ringleader with a malodorant, contained in a 'paint-ball' type capsule, may also urge people to move away from that person. Experiments are being conducted to evaluate the motivation necessary to overcome this urge. Olfactory agents appear to have considerable potential, though clearly more work is needed.

Long-Range Discriminating Devices

53. Chemical weapons described in the previous sections have been either long-range but indiscriminate, or discriminate but with a very short range. A number of rounds are now becoming available which combine long-range capabilities with a discriminate delivery of a chemical incapacitant. These devices combine blunt impact with chemical delivery.



Ring Airfoil Projectile

54. The Ring Airfoil Projectile (RAP) is a device which is currently under development by the National Institute of Justice. The RAP was initially developed more than 20 years ago for the American military, although it was never actually used by them, and was intended at that time to be launched by the M-16A1 rifle. The RAP is a light ring of rubber which has a cross sectional profile similar to that of an aircraft wing. The RAP therefore 'flies' to its target, which should result in an accurate long-range projectile.



Release of CS on Impact

55. Because it is light, it does not carry a great amount of kinetic energy and should not cause any serious injury. However, this also means it is unlikely to incapacitate. To increase the effectiveness of the RAP, chambers are moulded into the ring and filled with CS (or OC) and covered with a membrane. When the RAP hits the target, the membrane ruptures and produces a cloud of CS specific to the target.

56. Work is currently underway to develop a stand-alone, hand held launching device for the RAP. However, at present there are problems in reliably firing this weapon.

57. A number of other rounds available are in the form of balls filled with either CS or OC. These can be either multiple small balls or one large ball. The chemical, in the form of a powder or a liquid, is held within a spherical membrane which splits upon impact with the target, thereby releasing its contents. The smaller multiple balls are similar in size to 'paint-ball' type rounds. A larger round is also available which consists of a single ball (44mm calibre) filled with CS powder.

58. 40mm sponge cartridges have also been developed which contain a quantity of either CN, CS or OC. Upon impact, the rubber foam tip is compressed, thereby squeezing out the irritant powder contents. Significant impact energy may be imparted by the round to the target. These rounds are similar to the sponge grenades mentioned later in the impact section.

59. Other chemical means of incapacitation include the use of tranquillisers and anaesthetics. Different people will react differently to anaesthetics and the dose required to incapacitate one person may prove harmful to another.

Diversion and Distraction Devices

60. Options in this category tend to utilise methods of overloading the senses by sound, light, smell or a combination of these to produce a distracting or disorienting effect.

Sound and Flash Grenades



Training with Stun Grenades

61. Examples of this type of device include 'stun grenades' that emit one or more loud bangs and flashes of bright light. They are hand-thrown and are typically used in rapid entry situations where officers need to gain access to apprehend individuals before they can injure themselves or others. Some grenades function by discharging sub-munitions that provide the sound and flash. These have the potential to cause injury and the pyrotechnic nature of the sub-munitions may also create a fire hazard.

62. Smaller devices are also available that can be delivered by 12 gauge shotgun over ranges of 30 to 100 metres. Owing to size limitations of the projectile, they tend to only emit a single flash and bang for each round fired.

63. The disorientation effects may last several seconds, or even minutes, depending on the proximity of the individual to the device at the time of detonation.

64. Apart from the distraction effects of loud sounds, low frequency and high frequency sound has also been considered for use as an option to disperse people. Consensus at the moment is that this method of disorientation, using amplitudes unlikely to cause permanent damage, would be ineffective. The Joint Non-Lethal Weapons Program of the US Department of Defense officially terminated their acoustic weapons program in 1999, as it could not meet the specific transition criteria required for it to proceed further.

Smoke Grenades

65. There are numerous smoke grenades available that may be hand-thrown or weapon-delivered up to 100 metres. Their primary uses in the military role are for signalling or to obscure vision and prevent unwanted observation of activity. For law enforcement they could also be deployed for screening purposes or to create confusion. They may have limited application in policing scenarios and could have a number of disadvantages, for example, reducing the chances of positively identifying individuals and 'losing' identified individuals in the general confusion.

66. Smoke is either discharged from the main body of the grenade or from pellets ejected from the body. A single device can be kicked or thrown back towards police

lines more easily than the pellets, which can become extremely hot. These are all pyrotechnic devices and there is a fire risk, if they come into contact with combustible materials. Some of the compositions are also known to be respiratory irritants. Smoke grenades can take from 30 seconds to over a minute to discharge and the smoke will persist for several minutes, depending on local conditions.

67. Grenades are being developed which will also release malodorants or 'bad smells'.

Light Devices

68. Lasers and bright lights have also been considered for use as distraction or disorientation devices by virtue of the dazzle effect.



High intensity portable spotlight

69. High intensity portable hand-held (or vehicle mounted) spotlights have been available for some time and have been used to provide a low level of distraction by causing temporary blindness. They do not incapacitate as such, but prevent an individual from accurately placing a shot or throwing a missile. High intensity lighting can be used to illuminate areas up to 2 kilometres away, but the disorientation effect rapidly decreases with distance and is unlikely to be effective above 100 metres.

70. However, with equipment of this type rated from 750,000 up to 6 million candlepower, there is a risk of permanent eye damage at closer ranges. Rapidly pulsed (stroboscopic) high intensity light has a disorientating effect but is indiscriminate and there are concerns that it may induce epileptic seizure.



Hand-held laser dazzler

71. Laser weapon technology was initially developed as a military countermeasure against electrical and optical devices, including night vision equipment. Because lasers produce a highly focused beam, they can be used over considerable distances (several kilometres). However, this makes accurate aiming with a hand-held device more difficult and some devices use lenses or rapid horizontal and vertical scanning to increase the area of the beam.

72. As with high intensity portable lighting, lasers do not incapacitate but prevent an individual from accurately returning fire by causing temporary blindness in the central field of vision. Green lasers may be favoured over red, as the eye is more sensitive to light at this wavelength and therefore a lower powered device could be used to achieve a similar effect.

73. The greatest concerns with this type of weapon are issues of eye safety. Additionally, in bright sunlight it would appear that the power needed to be effective could lead to exposures above desirable levels.

Electrical

74. Electrical devices include any weapons which use the effects of electricity to incapacitate the target. There are a variety of different devices but their principle of operation is the same. They are battery powered and use a low current, high voltage impulse shock for incapacitation. The electrical stimulus delivered by the device **temporarily** interferes with the normal electrical signals generated by the human nervous system. Incapacitation by electrical means appears to offer a virtually instantaneous method of incapacitation with almost instant recovery, although some questions remain on delivery methods and on health effects.

Tasers

75. The most widely known and used electrical device is the taser. This was first built in 1970 and has been used by hundreds of police departments in the United States for many years. Taser is an acronym for 'Thomas A Swift Electric Rifle'.



Taser showing barbed electrodes

76. A cartridge is attached to the front end of the weapon which contains two barbs, the electrodes, each of which is attached to a coiled length of wire. The barbs are fired at the target and attach themselves to the skin or clothing of the targeted individual. The barbs are propelled by a small cylinder of compressed gas which is ruptured by a pyrotechnic mechanism within the cartridge. When the barbs strike a person, a current can be sent down the wires and through the person's body between the two barb points. This current interferes with and overrides the body's neuromuscular system and thus voluntary muscle control is lost between the two dart points, which usually results in the subject falling to the ground or 'freezing' in place.

77. During flight, the barbs separate at a specific angle so that one dart drops below the other. This allows the targeting of a greater number of muscle groups and thus enhances incapacitation. It is for this reason that, at the present time, the maximum range of a taser is 21' (6.4m) with some devices having a maximum range of only 15' (4.6m). Work is currently in progress to extend the range of these devices. However, this will necessarily mean reducing the distance between the barbs at shorter ranges. The barbs are capable of penetrating the subject's skin, although the taser is still claimed to be effective even when separated from the body by up to 2" of clothing. The barbs typically have an initial muzzle velocity of 55m/s. Dual and single shot versions are available, but not in all styles.

78. The taser represented in the picture above resembles a firearm. However, this is just one of a number of models available, some of which do not. Tasers use 50,000V of electricity and operate using pulse wave technology. Until recently, the available tasers had a power output of 5-7W. Tasers are now available with a power output of 26W. This is believed to make the device more effective, although it remains to be seen whether these claims prove to be true.

79. There are a number of potential problems with the taser in its current design and previous figures have shown its effectiveness to be between 55 and 86% (for older 5-7W tasers). There are a number of potential reasons for this and these are summarised below:

- one of the wires failing to attach or falling out would render the device ineffective;
- poor contact with the barbs;
- excessively thick or insulating clothing;
- flat batteries (batteries need replacing, extreme cold affecting batteries) or other electrical problems;
- operator difficulties (missing target, failure to hold down button to discharge current);
- abnormal physiological resistance to the electric shock. Some individuals have been found to have the potential to fight through the effects of the taser.

80. Some of these points have been addressed by the manufacturers and a number of models are now available with different characteristics.

Taser Safety

81. There is considerable debate in the literature about the safety of these types of electrical devices. The principal area of concern is whether it is possible to initiate ventricular fibrillation by the use of them. Ventricular fibrillation occurs when the regular beating of the heart is interrupted during the vulnerable period of the cardiac cycle - the consequences of this are that the heart stops beating, blood pressure falls rapidly and emergency resuscitation is required. The last 20 to 30 years experience with tasers has been with 5-7W output devices. Now that 26W systems are becoming more widely used, it is important to consider whether previous data on health and safety can be applied to the higher-powered systems.

82. There are concerns about the effects of the taser current on the body. A number of secondary injuries could also occur. These include:

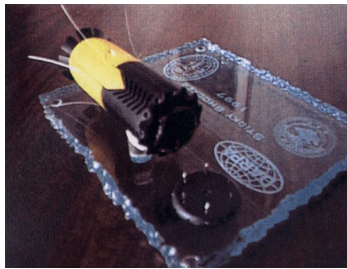
- blunt trauma injuries caused by the tasered person falling after being hit or the taser dart puncturing an eye;
- vulnerability of a person in contact with a flammable liquid;
- a small puncture wound on the subject's skin if a taser dart has punctured it. This will be accompanied by a redness of the skin caused by the electrical current of the taser.

Stun Guns

83. The stun gun is another common device which uses electricity to incapacitate. There are a number of different brands of stun gun but their mode of operation is generally similar to that of the taser except that the electrodes are attached to the device and do not have wires attached. This means that there is a need to approach the targeted individual much more closely which obviously has inherent risks. Some devices simply have electrodes that are pushed against the skin while others have barbs or spikes which stick into the skin. The area of contact, pressure of contact, presence of surface moisture and any skin damage can all affect the resistance of the body which will affect the current. The voltage output of these devices varies between 50kV and 200kV.

84. Stun guns may also be able to be used as a deterrent. If the weapon is discharged when not in contact with anything, there will be an electrical discharge between the two electrodes which ionises the air gap and produces an arc which will crackle and be clearly visible.

Other Electrical Devices



85. The Sticky Shocker is a device which is currently under development in the United States and combines electrical and impact methods. The device is a self contained, wireless projectile which is fired from large calibre compressed gas or powder launchers. The device sticks to the target either with a glue-like substance, or with short barbs. The projectile incorporates a battery pack and associated electronics that impart a short burst of high-voltage pulses (said to be similar to that of the taser), causing discomfort or incapacitation.

86. Devices are also under development to deliver an electric current via pathways of ionised air. The air would be ionised by an ultra-violet laser and two beams would be required to complete the circuit. This type of device is in its infancy and at present relies on paper claims which may not be proven in experiment.

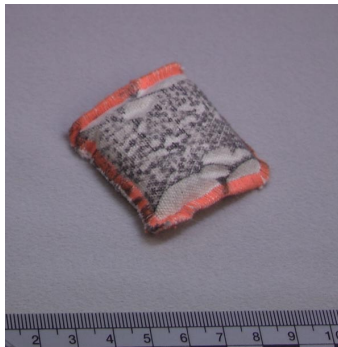
Impact

87. This type of equipment probably comprises the majority of commercially available less lethal products and includes bean bag rounds, sock rounds, sponge grenades and baton rounds (polymer, plastic, rubber or wood). There are many different manufacturers producing different types of round – for instance, there are at least twenty different types of bean bag round – and product accuracy, range and quality differ tremendously. Recent tests in America have shown more than half of various types of impact rounds on the market are unable to hit an 18" (450mm) diameter target at 25 yds (23m). In assessing impact rounds, a complex balance between effectiveness and unintended consequences is likely to have to be taken into

account. It is currently believed that, in order to be effective, the impact is such that striking vulnerable areas of the body runs a risk of causing serious injury or death. To be effective and safe requires control of the impact point. Hence, accuracy is one of the more important attributes of these types of round, if unintended injuries are to be minimised. For example, the manufacturers of one type of round recommend that it is not fired at the head, neck, heart or spine; if the round is inaccurate it may be impossible to do this with certainty. Recent innovations in baton round design and delivery systems have provided greater consistency at longer ranges, whilst reducing injury potential, particularly at closer ranges. This is a significant development. Some types of impact rounds attempt to spread the energy on impact; sponge grenade, sock round and liquid filled rounds are examples. This could reduce the seriousness of injuries but the accuracy, effectiveness and other attributes of these rounds need to be verified.

88. A brief generic summary of varieties of impact rounds follows.

Bean Bag



89. The bean bag consists of a square or circular envelope of fabric containing lead shot and is generally fired from a 12 gauge weapon, although it is also available in larger calibres including 37mm. Rounds are also available containing more than one bean bag. The round is intended to flatten on impact, hitting face on, and to spread its energy over a large area. Manufacturers' data indicate this type of round typically has a range of 5–30m depending on model type.

90. Possible problems with the round include inaccuracy, failure to open out and the 'frisbee effect' where the bean bag hits the target edge on. The bean bag round is the less lethal impact round most widely used within North American police departments. These rounds have been associated with deaths.

Sock Round



91. This round was developed because of the problems described earlier with the older style bean-bag rounds. The round contains a shot filled flexible 'sock'; typically 40mm in length, with a 50mm tail to aid stabilisation in flight.

92. Many variations on this design are available and are generally fired from a 12 gauge weapon. Range is 5–30m depending on model type. Possible problems include inaccuracy.

Powder Filled Rounds

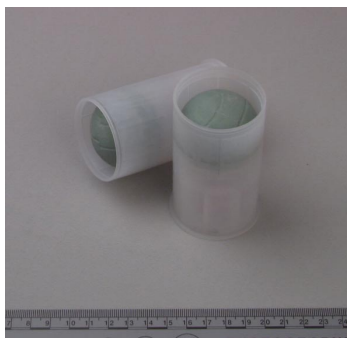
93. These are very soft, highly pliant, metal powder filled, silicon elastomer projectiles. Upon striking the target, the projectiles immediately expand radially and distribute their kinetic energy over a relatively large surface area in comparison to the round diameter. Fired from a number of different calibre weapons, the range is up to 40m.

Sponge Grenade



94. The projectile consists of a rubber foam sponge which deforms during impact, imparting the kinetic energy over a wider surface. The projectile engages the barrel rifling of the 40mm weapon and is thus spin-stabilised, giving increased accuracy. It is available with and without powdered irritant additives (CN, CS or OC). When irritant is present, the compression of the sponge serves to 'squeeze' out the irritant powder to form an irritant cloud at the target.

Rubber Ball Rounds



95. A number of rounds are available that fire a single soft rubber ball. Some of these are similar to squash balls and on impact, the ball is squashed and spreads its force over an area of approximately 35 cm². Range is relatively short, at approximately 12m; the light projectile quickly loses its energy at greater distances. Other cartridges containing soft balls of different size, weight and range are also available.

96. Variations contain irritants to enhance incapacitation, or dyes to act as a tag. With these rounds, the ball splits on impact to release its contents.

Fin Stabilised Rubber Projectile



97. This is a stabilised rubber round which is fired from a 12 gauge shotgun or compressed gas weapon. Range is up to 45m; the fins are added to the projectile to increase stability and hence improve accuracy at longer range.

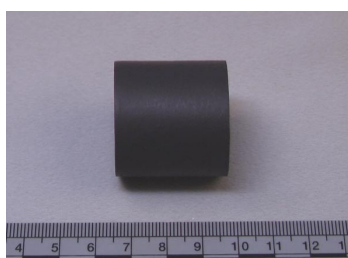
Multi Ball Rounds



98. A number of different rounds are available that deliver multiple rubber balls; most are designed to be fired from a standard 12 gauge shotgun but other calibres may also be found. These rounds are relatively indiscriminate and have ranges dependent on a number of factors including diameter of balls; number of balls; calibre of round and amount of propellant.

99. At close range, before the shot pattern has spread, they may impart a considerable amount of energy over a small area. However, the shot spreads rapidly and loses its energy quickly owing to the low mass of the balls, particularly the smaller sizes. These multi ball rounds can also contain irritant and/or dyes.

Baton Rounds (Commercially available)



Rubber (multi shot)



Wooden (multi shot)

100. These rounds are available to buy from commercial companies and are distinct from the baton rounds used by the police which are described in the next sub section.

101. There are a large number of different types of baton round available made from different materials, including wood, rubber and plastics. Multiple rounds are also available which will deploy a number of projectiles (generally three or five) at the same time. These rounds are normally fired from 37mm or 40mm weapons. Claimed ranges vary but are up to 100m. These rounds are particularly inaccurate and not designed to be aimed at an individual. Skip-firing, or bouncing the round(s) off the ground in front of the crowd, are the recommended deployment of most rounds. This will make the round's trajectory unpredictable.

Baton Rounds (used by UK police and military)



The L5A7 Round

102. Baton rounds used by the police have evolved steadily since their first use in Northern Ireland in 1973. Initially these rounds were made of rubber but this was found to be inaccurate, so they were completely replaced by plastic rounds in 1975. These rounds have gone through various redesigns over the years, generally to improve accuracy. Since 1994, an improved rifled baton gun (the L104) has also been in use.

103. The current round is designated the L5A7 (model L5, revision 7) and has had no deaths associated with its use. In July 1996, 8,165 baton rounds of this series were fired at Drumcree and elsewhere, resulting in 172 injuries on 155 patients examined in hospital. There were no fatalities but three patients required treatment in intensive care units. Since that year, the number of baton rounds fired has been very greatly reduced. A report by Steele et al reinforces the need for accuracy to avoid impacts to the abdomen or above.



The L21A1 Round

104. A programme to improve the characteristics of the baton round has been recently completed and a new round, designated L21A1, has been produced. The sighting system for the baton gun has also been vastly improved and the new round along with the new sighting system offers much improved accuracy. Medical reviews of the round indicate the new system will reduce the incidence of life threatening injuries by virtue of the increased accuracy.

Water Cannon



Vehicle

105. Included in the impact group of options are water cannon. They have been used in Europe on many occasions, most notably during the Euro 2000 competition and research into their effectiveness has been carried out in the UK in the past. A Belgian water cannon was used at Drumcree last year. Water cannon are large, expensive and may have logistical problems with deployment during spontaneous public order situations. They may be better suited to planned operations.



Portable System

106. There are also portable water systems available, where a pressurised water reservoir is carried on the officer's back. These tend to be heavy and unwieldy but may merit further investigation. Most are capable of firing either a jet or 'pulsed' slug of water. It is possible to use the water to deploy incapacitants such as OC, CN or CS.

Mechanical Devices

107. This category encompasses devices such as nets, bolas, glue, grease and other options used physically to prevent or hamper people moving.

Nets and Wire Entanglement Systems



An Eastern European muzzle-launched net system.

108. The net and bolas systems available do not tend to work well on people who are moving. At close range, there is likelihood that the devices will not be sufficiently deployed to entangle the subject and may actually impart considerable kinetic energy. They cannot be used in confined spaces or in areas where they may become entangled in trees or shrubs. Their range is also somewhat limited, with a maximum of around 10 to 15 metres. Most systems use weights around the net to aid its spread, which could cause injury to bystanders or the targeted individual. A number of launch systems are used to deploy them and several require purpose-made weapons to fire them. Some may be fired from conventional firearms, either in cartridges



Bolas-type projectile

or by using blank rounds to discharge them from the muzzle.

109. There are some concerns regarding the latter method of deployment, as blanks (as opposed to grenade launching cartridges) are not intended for firing projectiles. Most are filled with a fast burning propellant that must generate sufficient pressure to cycle the weapon. Obstructing the muzzle of the weapon with a significant mass could potentially exceed the proof pressure of the weapon and cause irreparable damage and/or injure the firer.

110. Some of the more extreme variations on the entanglement theme utilise other additional methods of incapacitation. These include nets impregnated with adhesives or chemical irritants and products incorporating electrical stun devices to incapacitate the subjects as well as restraining them.

Glue and Grease Systems

111. Glue and grease systems currently lack a quick method of 'decontamination'. Areas and objects coated in glue or grease may need to be used by police personnel or as an escape route and, in any event, would need to be decontaminated after deployment.

112. Targeting individuals with glue may have some merit, providing the glue is quick setting, non-toxic and easy to remove.



Demonstration of the Glue Gun

113. An example of this type of system is the 'sticky foam' or 'glue gun'. The foam is stored under pressure in a canister and expands to over 30 times its stored volume when dispensed. It can be discharged from a backpack or shoulder-carried weapon.

114. It incapacitates by entangling the individual with extremely tacky material at a range of up to 10 metres. The current system is capable of multiple shots but owing to its extreme tenacity it will tend to stick to anything with which it comes into contact and requires considerable effort to remove it from skin and other materials. If the foam comes into contact with the mouth or face, there is a serious risk of suffocation.

115. Low friction substances such as non-hazardous chemical sprays, foam or grease can be applied across road surfaces or pavements to deny access to specific areas. This requires some previous knowledge to allow sufficient planning for their deployment. While they may deter a crowd or individuals from crossing a line, they equally prevent the police from going forward to make arrests or disperse the group.

Once the disorder has been brought under control or the crowd has dispersed, the slippery surface requires cleaning and neutralising to prevent risk to innocent pedestrians and road users.

Conclusion

116. As can be seen, there are a number of options which could be developed to provide a broader range of equipment for use in a public order situation. Unfortunately acceptable, effective and less potentially lethal alternatives to the baton round are more elusive. The L5A7 baton round system (utilising the L104A1 baton gun) has had no deaths associated with its use, although that is not to say that this system is not *potentially* lethal. Any new system would need to be acceptable, have the same as or better performance and effectiveness than the L5A7 round, and be less potentially lethal.

Acknowledgements

117. During this review, the Police Scientific Development Branch has drawn heavily from its overseas contacts. These include organisations in Canada, Europe and the United States. One organisation in particular needs a special mention, the National Institute of Justice (NIJ), part of the US Department of Justice. PSDB has a Memorandum of Understanding with the NIJ.

118. The NIJ is the research and development arm of the Department of Justice. Its effort is specifically tailored to meet the needs of state, local law enforcement and corrections (prisons) agencies. Within the NIJ sits the Office of Science and Technology (OST) which was formerly known as the National Institute for Law Enforcement and Criminal Justice.

119. Work in less lethal technologies (referred to as less than lethal or non-lethal in the US) has been a priority area for the OST for a number of years. It is currently examining a number of developments in a number of areas and has been more than willing to share information. It is acutely aware of the police (as opposed to military) requirements for these types of technology, recognised in the Patten Report. Appendix A summarises the current projects funded by the NIJ in this area.

120. In addition to the contact with the NIJ, many other organisations have also been helpful during the review and are listed on the next page.

Organisation	Country
Canadian Police Research Centre	Canada
Ottawa-Carlton Region Police Force	Canada
Royal Canadian Mounted Police	Canada
Centre de Recherche et D'Etudes de la Logistique de la Police (CREL)	France
Bundeskriminalamt (BKA)	Germany
Polizei-Fuhrungsakademie (PFA)	Germany
Swedish National Police Board	Sweden
Stadtpolizei	Switzerland
Association of Chief Police Officers and many individual police forces.	UK
Defence Evaluation Research Agency	UK
Ministry of Defence	UK
Royal Ulster Constabulary	UK
Air Force Research Laboratory	US
Joint Non Lethal Weapons Directorate	US
Los Angeles Sheriff's Department	US
Missouri Police Department	US
National Institute of Standards and Technology	US
Pennsylvania State University	US
United States Marine Corps at Quantico	US
Wayne State University	US

In addition to the above organisations the assistance of manufacturers and suppliers has also been invaluable. Members of the Steering Group have also benefited from attendance at two international conferences – the Belgium and South African conference held in Brussels on public order and community policing in November 2000, and the Change International conference on non-lethal weapons in December 2000.

Appendix A
NIJ Funded Research

Technology Development Portfolio

Less-than-Lethal

The purpose of this portfolio is to identify, develop, and evaluate new or improved devices and other technology that will minimise the risk of death and injury to law enforcement officers, suspects, prisoners, and the general public. In addition, the less-than-lethal program contributes to the reduction of civil and criminal liability suits against police, sheriff, and corrections departments. Some of the projects currently under development or evaluation are acoustic (bioeffects), chemical (pepper spray), electrical (stun devices and projectiles), kinetic energy projectiles (shot bags and ring airfoil projectiles), light (lasers, flashing bright lights), nets (baton launched, projectile launched), and fleeing vehicle interdiction (mechanical and electric/electromagnetic). Future development and demonstration of electrical vehicle stopping devices is currently being planned. Information on the demonstration of electrostatic discharge vehicle stopping devices is available on the [NIJ On-Line Portfolio](#).

Detailed information on all individual NIJ awards in this portfolio may be found on [NIJ On-Line Portfolio](#).



**Research
Portfolio**



Detailed Information

Award Title: Public Acceptance of Police Technologies

Award Number: 1993IJCXK012

Awardee: Institute for Law and Justice Inc

Awardee Contact: TOM McEWEN
1018 Duke Street
Alexandria, VA 22314

Original Funds: Year: 1993, Amount: \$150,000.00

Additional Funds: Year: 1998, Amount: \$100,000.00
Year: 1999, Amount: \$ 99,859.00

Total Funds: \$349,859.00

Categories: Less-than-Lethal Technology
Policing Technology
Technology Development
Program Assessment, Policy, and Coordination

National Study: Yes

Project Description: 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.

Detailed Information

Award Title: Aqueous Foam System

Award Number: 1994IJCXA025

Awardee: Sandia National Laboratories

Awardee Contact: STEVE SCOTT
PO Box 5800, MS 0762
Albuquerque, NM 87185

Original Funds: Year: 1994, Amount: \$292,000.00

Categories: Corrections
Less-than-Lethal Technology
Technology Development

Project Location: Albuquerque, Bernalillo, New Mexico

Project Description: Establish requirements for use of aqueous foam as a means to combat violent behaviour in a correctional environment, assess health and safety risks, and evaluate effectiveness.

Detailed Information

Award Title: Evaluation of Oleoresin Capsicum and Stun Device Effectiveness

Award Number: 1994IJCXK006

Awardee: National Sheriff's Association

Awardee Contact: JACK GRIFFIN
1450 Duke Street
Alexandria 22314

Original Funds: Year: 1994, Amount: \$349,622.00

Categories: Less-than-Lethal Technology
Policing Technology
Technology Development
Use of Force

Project Location: Maricopa County, Arizona

Project Description: The National Sheriff's Association will evaluate the reduction in injuries and use-of-force complaints of two commercially available, less-than-lethal devices in a jail setting, pepper spray and handheld electrical stun devices. Although both devices are currently in use in some jails and prisons around the country, and pepper spray is used widely in street confrontations by police and sheriff's departments, systematic studies on effectiveness of these tools within jails are lacking.

In this 21 month study, to be concluded in the Maricopa County Arizona Sheriff's Office (5,000 daily inmate population), data will be collected from surveys, device use reporting forms, follow-up interviews, and focus group meetings with randomly selected jail staff. Data will also be collected that will allow a determination to be made of changes in the rate of injuries to officers and prisoners before and after the introduction of these devices to the jail.

Results of the data analysis will provide valuable information to the administrators of jails nation-wide as they consider whether to use these devices in their facilities and, depending on the results, departments already using them may want to modify existing procedures and policies governing their use.

Detailed Information

Award Title: Less-than-Lethal Technology Assessment and Transfer Grant

Award Number: 1995IJCXK003

Awardee: Booz, Allen and Hamilton Inc

Awardee Contact: DONALD VINCENT
8283 Greensboro Drive
McLean, VA 22102

Original Funds: Year: 1995, Amount: \$244,629.00

Categories: Less-than-Lethal Technology
Technology Development
Program Assessment, Policy, and Co-ordination

Project Location: McLean, Fairfax County, Virginia

Project Description: To design, establish and implement a process for supporting NIJ in assisting the transfer of less-than-lethal (LTL) technologies into policing and correctional operations. Acceptance criteria for less-than-lethal products and test and evaluation protocols, which can be used for their development, will be the product of this project. These protocols and product criteria will be used to guide the development of new LTL technology and/or identify missing critical information that needs to be collected and analyzed regarding existing or developing technologies. Successful application of such guidelines should help ensure that new LTL products can be put into operation with a minimum of health and safety risks and little or no negative reaction from the public.

Although the guidelines and protocols will be generic, the use of pepper spray by police and correctional officers will be used as a case study to show how the process can be applied.

Detailed Information

Award Title: Law Enforcement Technology, Technology Transfer, Less-Than-Lethal Weapons Technology and Policy Liability Assessment

Award Number: 1996LBVXK006

Awardee: Seaskate Inc

Awardee Contact: E A BURKHALTER
555 13th Street NW
East Tower - 501
Washington, DC 20004

Original Funds: Year: 1996, Amount: \$198,287.00

Additional Funds: Year: 1998, Amount: \$255,628.00
Year: 1999, Amount: \$259,719.00
Year: 2000, Amount: \$276,264.00

Total Funds: \$989,898.00

Categories: Less-than-Lethal Technology
Technology Development

Project Location:

Project Description: This award addresses science and the law and assesses and makes recommendations regarding liability issues that might arise from deployment of new technologies.

Detailed Information

Award Title: Law Enforcement Technology, Technology Transfer, Less-Than-Lethal Technology and Policy Assessment

Award Number: 1996MUMUK016

Awardee: Seaskate Inc

Awardee Contact: E A BURKHALTER
555 13th Street NW
East Tower - 501
Washington DC 20004

Original Funds: Year: 1996, Amount: \$233,266.00

Additional Funds: Year: 1997, Amount: \$ 46,852.00
Year: 1998, Amount: \$705,732.00
Year: 1999, Amount: \$486,212.00
Year: 2000, Amount: \$433,893.00

Total Funds: \$1,905,955.00

Categories: Less-than-Lethal Technology
Technology Development

Project Location:

Project Description: A policy and technology assessment panel is identifying promising law enforcement and corrections technologies from the defence, intelligence, and private sector arenas in the short and long terms, as well as best approaches in introducing them to the criminal justice community.

Detailed Information

Award Title: Ring Airfoil Projectile System for Less-Than-Lethal Application

Award Number: 1997IJCXK019

Awardee: Guilford Engineering Associates, Inc

Awardee Contact: DAVID FINDLAY
332 Stepstone Hill Road
Guilford, CT 06437

Original Funds: Year: 1997, Amount: \$199,788.00

Additional Funds: Year: 1998, Amount: \$249,303.00
Year: 1999, Amount: \$299,182.00
Year: 2000, Amount: \$294,750.00

Total Funds: \$1,043,023.00

Categories: Less-than-Lethal Technology
Policing Technology
Technology Development

Project Location: Guilford, New Haven County, Connecticut

Project Description: 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 non-lethal 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, in a recent demonstration, law enforcement practitioners observed that the RAP had potential law enforcement use as an alternative to existing rubber bullet and shot-bag projectiles. It is non-lethal at the muzzle, even with a head impact. Because it is an airfoil, it has a longer 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. Thus, there is the need to develop alternative launch mechanisms for law enforcement use. NIJ has provided a grant to Guilford Engineering, Inc. to design and develop a

stand-alone, throw-away launch device for the RAP. In addition, Guilford Engineering will conduct a feasibility study to investigate the possibility of delivering a small "cloud" of pepper spray to a targeted subject hit with the RAP.

Status:

A prototype hand-held launcher was demonstrated in April 1999. Efforts are underway to investigate and examine pepper powder placed in the cavities of the RAP such that it disperses on RAP impact. Tools have been developed to form a production quality disposable cartridge containing the RAP. Over the next six months, tools will be made to produce a production-quality launch device for the RAP cartridge. In addition, a production process for placing pepper powder in the cavities of the RAP will be established.

Detailed Information

Award Title: Health Hazard Assessment for Kinetic Energy Impact Weapons

Award Number: 1997LBVXA024

Awardee: US Department of the Army, Medical Research and Materials Command

Awardee Contact: MAJOR GREGORY J ARGYROS
VA

Original Funds: Year: 1997, Amount: \$100,000.00

Categories: Corrections
Less-than-Lethal Technology
Policing Technology
Technology Development

Project Location: Arlington, Virginia

Project Description: This award provides support, assistance, and resources to the US Army Medical Research and Material Command to assess non-lethal blunt impact munitions and delivery systems for health hazard effects.

Detailed Information

Award Title: An Evaluation of Oleoresin Capsicum

Award Number: 1997LBVXK018

Awardee: University of North Carolina - Chapel Hill

Awardee Contact: MICHAEL BOWLING
300 Bynum Hall, CB 4100
Chapel Hill, NC 27599

Original Funds: Year: 1997, Amount: \$218,000.00

Categories: Less-than-Lethal Technology
Policing Technology
Technology Development

Project Location: Charlotte-Mecklenburg, North Carolina
Winston-Salem, North Carolina

Project Description: This study will examine the effectiveness of oleoresin capsicum spray to law enforcement by analyzing data on assaults, injuries, and complaints alleging excessive force.

The research will:

- Extract injury, use of force, assault and complaints of excessive force data from the NC State Highway Patrol, the Charlotte-Mecklenburg Police Department and the Winston-Salem Police Department before and after OC was introduced.
- Analyze data to estimate the effect of OC policies on injury rates to officers and suspects compared to injury rates before OC was available to the departments.

Detailed Information

Award Title: Pepper Spray Projectile/Dispenser

Award Number: 1997MUMUK011

Awardee: Delta Defense, Inc

Awardee Contact: ROY KELLY
1111 Jefferson Davis Highway
Arlington, VA 22202

Original Funds: Year: 1997, Amount: \$115,754.00

Additional Funds: Year: 1997, Amount: \$135,022.00

Total Funds: \$250,776.00

Categories: Less-than-Lethal Technology
Policing Technology
Technology Development

Project Location: Arlington, Virginia

Project Description: This award supports design and testing of an improved projectile capable of dispersing oleoresin capsicum (pepper spray) for use in hostage, barricade and tactical assault situations.

Detailed Information

Award Title: Laser Dazzler Assessment

Award Number: 1998DTCXA040

Awardee: US Air Force Research Laboratory

Awardee Contact: CHAD LINDSTROM
3550 Aberdeen Avenue SE
Kirtland AFB, NM 87117

Original Funds: Year: 1998, Amount: \$290,000.00

Categories: Less-than-Lethal Technology
Policing
Policing Technology
Technology Development

Project Location: New Mexico

Project Description: To conduct an evaluation of a handheld laser dazzler to determine its safety, effectiveness, and suitability for law enforcement operational testing.

Detailed Information

Award Title: Impact of OC Spray on Respiratory Function in the Sitting & Prone Maximal Restraint Positions

Award Number: 1998IJCX0079

Awardee: University of California - San Diego- Office of Contract & Grant Administration

Awardee Contact: THEODORE C CHAN
9500 Gilman Drive
La Jolla, CA 92093

Original Funds: Year: 1998, Amount: \$128,176.00

Categories: Less-than-Lethal Technology
Policing Technology

Project Location: La Jolla, California

Project Description: Using 35 volunteer police recruits, this study will evaluate the safety of Oleoresin Capsicum (OC) pepper spray, with and without positional restraint. The project will employ a randomized, cross-over, controlled trial design to determine: 1) if OC spray inhalation in the sitting position results in significant respiratory compromise as measured by pulmonary function testing and assessment of oxygenation ventilation; 2) If OC spray followed by the prone maximal restraint results in significant respiratory compromise as measured by pulmonary function testing and assessment of oxygenation and ventilation; and 3) whether other factors, such as body size, obesity, and mild asthma influence the effects of OC spray or positional restraint in regards to respiratory and pulmonary function testing and assessment of oxygenation and ventilation.

Detailed Information

Award Title: Evaluation of the Human Effects of the Sticky Shocker Topic

Award Number: 1998IJCXK006

Awardee: Pennsylvania State University -Office of Sponsored Programs

Awardee Contact: PAMELA R KAUFFMAN
110 Technology Center
University Park 16802

Original Funds: Year: 1998, Amounts: \$99,600.00

Categories: Less-than-Lethal Technology
Policing Technology
Technology Development

Project Location: University Park, Pennsylvania

Project Description: NIJ and DARPA through the Joint Programme Steering Group (JPSG) funded JAYCOR will develop the Electric Stun Projectile, a less-than-lethal projectile that uses stun gun technology to temporarily incapacitate a person at stand-off ranges. The Electric Stun Projectile is a low-impact, wireless projectile fired from compressed gas or powder launchers and is accurate to a range of 10 meters, sticking to the target with a glue-like substance or with short, clothing attachment barbs. The projectile incorporates a battery pack and associated electronics that impact a short burst of high-voltage pulses capable of penetrating several layers of clothing. The pulse characteristics are similar to well-established non-lethal electrical shock devices, and will disable individuals or cause extreme discomfort. Applicable missions include any stand-off encounter where an individual needs to be temporarily incapacitated without exposing law enforcement officers to unnecessary risk. When safety certification is completed, field trials can be conducted. The Electric Stun Projectile will be evaluated for safety in the near future. NIJ may then fund some field tests.

Prototype development is complete and has been demonstrated on practice targets. NIJ funded a Human Effects Advisory Panel from the Pennsylvania State University's Institute for Non-lethal Defense Technologies

to expand the understanding of the human affects of the Electric Stun Projectile on the range of the human population based on available information. The results of this study show that very little is known about the health effects of electrical stun devices. NIJ will be funding a health effectiveness study on electrical devices in FY00 to better understand the health effects of electrical devices.

Detailed Information

Award Title: Evaluation of Vehicle Stopping Electromagnetic Prototype Devices

Award Number: 1998LBVXA099

Awardee: US Department of the Army

Awardee Contact: E SCANNELL
US Army Research Laboratory
ATTN: AMSRL-SS-SM
2800 Powder Mill Road
Adelphi, VA 20783-1197

Original Funds: Year: 1998, Amount: \$250,000.00

Categories: Less-than-Lethal Technology
Policing Technology
Technology Development
Vehicle Stopping Technology

Project Location: Adelphi, Maryland

Project Description: ARL provided engineering test support to conduct a Phase III vehicle stopping field test evaluation of electrostatic discharge (ESD) devices. Vendor-provided ESD devices were tested against vehicles operated under their own power, at up to moderately high speeds, in open-road and in check-point operational scenarios. ARL provided engineering test support in conducting a Phase II evaluation of the same two ESD devices in a laboratory setting.

Detailed Information

Award Title: Research and Establish a Computerized Database of Firearm Delivered Less Lethal Impact Munitions

Award Number: 1998LBVXK006

Awardee: Pro Tac International

Awardee Contact: KEN HUBBS
PO Box 191462
San Diego, CA 92159

Original Funds: Year: 1998, Amount: \$84,770.00

Categories: Less-than-Lethal Technology
Policing Technology
Technology Development

Project Location: San Diego, California

Project Description: This project will produce a database of the actual use of less-than-lethal, blunt impact projectiles. The database will be used to assess the effectiveness of less-than-lethal weapons so that law enforcement agencies can make informed decisions when choosing less-than-lethal equipment, devices, and munitions. In addition, the database can be used as a baseline to determine requirements for future less-than-lethal technologies. The less-than-lethal blunt impact projectile information will be attained through distributing questionnaires nation-wide to law enforcement and corrections agencies that are users of these munitions.

Detailed Information

Award Title:	Biomechanical Assessment of Non-Lethal Weapons
Award Number:	1998LBVXK017
Awardee:	Wayne State University
Awardee Contact:	CYNTHIA BIR Department of Criminal Justice 710 Mackenzie Hall Detroit, MI 48202
Original Funds:	Year: 1998, Amount: \$148,276.00
Additional Funds:	Year: 1999, Amount: \$198,382.00 Year: 2000, Amount: \$369,983.00
Total Funds:	\$716,641.00
Categories:	Less-than-Lethal Technology Policing Technology Technology Development
Project Location:	Detroit, Michigan
Project Description:	<p>Law enforcement agencies as well as military agencies are relying on non-lethal, blunt impact projectile technology to diffuse potentially life threatening situations without the use of lethal force. However, a standardized method for testing these non-lethal devices for level of injury has not yet been established.</p> <p>Although the automobile industry has developed and validated biomechanical human surrogates, the impacts of non-lethal munitions are different in terms of velocity and mass. Automotive impacts entail a large mass at low velocity while non-lethal projectile munitions entail low mass, high velocity impacts.</p> <p>Thus a new biomechanical surrogate for non-lethal 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</p>

agencies with the ability to test all non-lethal blunt impact projectiles for risk of injury.

Product:

Title: Model for LTL Impact Effects

Detailed Information

Award Title: Preliminary Characterization and Safety Evaluation of Defense Technology's OC Powder

Award Number: 1999IJCXK019

Awardee: Chemical Delivery Systems, Inc

Awardee Contact: VICTOR CRAINICH
PO Box 292677
Kettering, OH 45429

Original Funds: Year: 1999, Amount: \$99,700.00

Categories: Less-than-Lethal Technology
Policing Technology
Technology Development

Project Location: Kettering, Ohio

Project Description: 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, Def Tech (DTP), may potentially be utilized in lieu of developing a new powder formulation.

The following tasks are anticipated to fulfil the Programme objective: 1) Preliminarily characterize the physical and chemical properties of the commercially available DTP; 2) Characterise 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.

Product: Title: Final Report

Detailed Information

Award Title: Evaluation of Vehicle Stopping Electromagnetic Phototype Devices - Phase III

Award Number: 1999LTVXK003

Awardee: JAYCOR Defense Sciences Group

Awardee Contact: DUNCAN STEWART
9775 Towne Centre Drive
San Diego, CA 92121

Original Funds: Year: 1999, Amount: \$78,780.00

Categories: Less-than-Lethal Technology
Policing Technology
Technology Development
Vehicle Stopping Technology

Project Location: Alexandria, Virginia
California

Project Description: The awardee will perform limited developmental work on its Auto Arrestor Vehicle Stopping Device. The developmental work will be performed to render the device more suitable for use in field testing.

Subsequently, the awardee will fabricate a prototype Auto Arrestor device and provide it to the National Institute of Justice for evaluation in a Phase III Vehicle Stopping Field test. The intent of the test is to ascertain the functional capability of the device to safely and effectively stop commercial automobiles, small trucks, sport utility vehicles, and similar vehicles.

Detailed Information

Award Title: ROAD SENTRY Vehicle-stopping Prototype Electrostatic Discharge (ESD) Device

Award Number: 1999TVXK005

Awardee: Non-Lethal Technologies, Inc

Awardee Contact: DAVID PACHOLOK
1815 Higgins Road
Dundee, IL 60118

Original Funds: Year: 1999, Amount: \$12,370.00

Categories: Less-than-Lethal Technology
Policing Technology
Technology Development
Vehicle Stopping Technology

Project Location: Dundee, Illinois

Project Description: The awardee will fabricate an operable prototype Road Sentry and provide it to the National Institute of Justice for evaluation in a Phase III Vehicle Stopping Field Test. The intent of the test is to ascertain the functional capability of the device to safely and effectively stop commercial automobiles, small trucks, sport utility vehicles, and such vehicles.

Detailed Information

Award Title: Applicability of Non-Lethal Weapons Technology in Schools

Award Number: 1999LTVXK023

Awardee: DynMeridian Corporation

Awardee Contact: MICHAEL HEANEY
6101 Stevenson Avenue
Alexandria 22304

Original Funds: Year: 1999, Amount; \$80,846.00

Categories: Less-than-Lethal Technology
Schools
Technology Development

Project Location: Stafford County, Virginia

Project Description: The proposed project will study the applicability of less-than-lethal (LTL) technology in school settings and will assess whether, where, and how LTL technologies, concepts, and operational approaches could make a significant and cost-effective contribution to the safety and security of US schools.

The five specific objectives of the project are to: 1) Characterize and categorize the psychological, physical, and legal school environments in which LTL technologies might be used; 2) Identify the principal school-oriented scenarios in which LTL technology would be helpful; 3) Identify the operating concepts, tactics, and techniques typically used by law enforcement agencies that may have to use LTL technology in a school environment and scenario; 4) Identify classes and characteristics of specific LTL technologies, including what makes them less-than-lethal; and 5) analyze the potential utility, effectiveness, and cost of applying these specific technologies and systems.

These objectives will be achieved by working with Stafford County, VA high schools, the National Association of Secondary School Principals and the International Union of Police Associations.

Appendix B

List of Reference Sources

A Literature Review of Solvents Suitable for the Police CS Spray Device

PSDB

DR P RICE, DR D W JONES AND D STANTON

November 1997

A report reviewing the available literature with regards to finding a solvent for CS with chemical and physical properties which would make it suitable for use in the CS spray and which will also have a low toxicity value.

A Review of Police Trials of the CS Aerosol Incapacitant

Home Office

EGMONT KOCK AND BERNARD RIX

Police Research Series, Paper 21

November 1996

This document is a summary of the six-month trial of CS spray by 16 police forces in England and Wales in 1996. The objective was to assess the suitability and effectiveness of the CS incapacitant as an item of police defensive equipment.

A Review of the Toxicology of the Riot Control Agent O-Chlorobenzylidene

PSDB

DR PAUL RICE AND MRS BRONWEN

IT 4900

1 December 1994

A report reviewing the readily available information regarding the toxicology of CS in the context of its use as an incapacitant delivered from small, personal pressurised canisters as a liquid aerosol. The report also compares this information with that available for other candidate incapacitants from the point of view of operational health and safety.

A Toxicological Review of Capsaicinoid (Oleoresin of Capsicums)

Canadian Police Research Centre

JOSEPH A RUDDICK

TR-02-93

January 1993

A literature study focusing on the toxicological effects following acute exposure of a subject to OC. The focus was on effects that can result following a short term exposure to the skin, eye or respiratory system.

Acoustic Weapons – Myths and Reality

JURGEN ALTMANN

1 November 1999

This is a brief general report prepared for a conference. It attempts to differentiate between the myths conveyed about the affects of acoustic weapons and the actual scientific facts discovered in relation to their effects on humans.

Alternative to Lethal Force – Capsicum Spray

Canadian Police Research Centre

P JAMIESON

TR-04-91

December 1991

A report on a six-month operational trial of Cap-Stun pepper spray within seven British Columbia Municipal Police Departments in Canada.

An Analysis of Preventive Methods for Baseball-Induced Chest Impact Injuries

D H JANDA, D C VIANO, D V ANDRZEJAK AND R N HENSINGER

6 November 1991

The aim of this study was to evaluate a non-living laboratory model for the low-mass, high-velocity chest impact scenario associated with baseball impact deaths in children. The tests involved baseball impacts to the chest of swine and to two modified crash test dummies.

Assessing the Blunt Trauma Potential of Free Flying Projectiles for Development

Battelle Columbus Operations (US)

JEFFREY M WIDDER, DONALD J BUTZ AND JANICE M MILOSH

This paper is a review of previous work on the impact testing of animals by non-penetrating projectiles and other blunt impact studies. The paper attempts to correlate data from previous, often restricted, studies in an attempt to derive meaningful guidelines for the design and proof-testing of less lethal projectiles.

Biochemical Predictor of Commotio Cordis in High-Speed Chest Impact

CYNTHIA A BIR AND DAVID C VIANO

September 1999

Commotio cordis is a term used to describe cases of blunt thoracic impact causing fatality without gross structural damage of the heart and internal organs. This paper attempts to determine which biomechanical parameter predicts the occurrence of commotio cordis and relate this to the level of chest compression, rate of chest deformation and viscous criterion.

Capsaicin-Induced Desensitisation of Airway Mucosa to Cigarette Smoke

JAN M LUNDBERG AND ALOIS SARIA

March 1983

The report details the findings of a study on rats to determine whether pre-treatment with capsaicin produces desensitisation to mechanical and chemical irritants in the mucosa of the respiratory tract.

Central and Peripheral Impairment of Thermoregulation After Capsaicin Treatment

F OBAL JR, F OBAL, G BENEDEK AND A JANCZO-GABOR

1983

Details a study on rats carried out to determine whether capsaicin interferes with heat sensors, both centrally and peripherally. The function of salivary cooling, vasodilation and behavioural thermoregulation, the preoptic heat sensitivity and the skin heat sensitivity were studied in rats pre-treated with capsaicin. All these heat-dissipating mechanisms were found to be impaired.

Changing Trends in Paintball Sport-Related Ocular Injuries

M S FINEMAN, D H FISCHER, J B JEFFERS, D G BUERGER AND C REPKE

2000

The aim of this report is to describe the type and severity of ocular injuries caused by paintballs. It looks at 35 patients who had sustained ocular injuries caused by paintballs over a 13 year period.

Chemical Analysis of Oleoresin Capsicum Products

Canadian Police Research Centre

MR G GARDNER

TR-07-92

March 1992

Aerosol canisters from three manufacturers of OC products were examined by various chemical techniques in order to determine their contents. The results were then compared with the information supplied by the manufacturer on their Material Safety Data Sheets.

Crowd Control Technologies (An appraisal of technologies for political control)

European Parliament

OMEGA FOUNDATION

PE 168.394/Fin.St.

June 2000

This is a working document for the Scientific and Technological Options Assessment (STOA) Panel produced by the Omega Foundation. Its focus is: to examine the bio-medical effects and the social and political impacts of currently available crowd control weapons in Europe; and to analyse world-wide trends and developments including the implications for Europe of a second generation of less lethal weapons.

CS Spray: Increasing Public Safety

POLICE COMPLAINTS AUTHORITY

ISBN 0-9533157-4-6

1 March 2000

A research project detailing an analysis of CS spray by compiling all complaints and information from questionnaires to all police forces in England and Wales. Recommendations towards the better, safer, lawful use of CS sprays.

Discussion of “Effects of the Taser in Fatalities Involving Police Confrontation”

TERENCE B ALLEN, MD

1991

An interesting discussion of the article from Kornblum and Reddy: “Effects of the Taser in Fatalities Involving Police Confrontation”. This document refutes much of what is said in the original article.

Disturbances of Thermoregulation Induced by Capsaicin

J SZOLCSANYI

1983

A study on rats to examine the effects of capsaicin on thermoregulation disturbances.

Effects of the Taser in Fatalities Involving Police Confrontation

RONALD N KORNBLUM (MD) AND SARA K REDDY (MD)

March 1991

This article examines the deaths of 16 young males in America after a taser weapon had been used on them. The report aims to determine whether the taser had caused or contributed to any of these deaths.

Electric Shock Devices and Their Effects on the Human Body

Forensic Science Service, Cambridge (UK)

M N ROBINSON, C G BROOKS AND G D RENSHAW

Med. Sci. Law (1990) Vol 30 No 4

1990

This technical booklet investigates electrical outputs from stun guns, shock batons and cattle prods. The output parameters are then related to the available information on the effects of electric current on the human body and on the electro-immobilisation of farm animals in an attempt to understand the possible hazardous effects of these outputs on the human body.

Electric Shock, Parts I, II and III

DR RAY FISH

9 September 1992

This is a 3-part series on electric shock. Part I: Physics and Pathophysiology; Part II: Nature and Mechanisms of Injury; and Part III: Deliberately Applied Electric Shocks and the Treatment of Electric Injuries.

Electronic Restraint Device: The Taser

International Association of Chiefs of Police, National Law Enforcement Policy Centre

Training Key No 497

1 February 1998

A document which describes the taser and its operation and outlines training actions and operational considerations for its use.

Evaluation of Pepper Spray for the Winnipeg Police Department

Canadian Police Research Centre

SGT D WILLIAMS

TM-11-94

February 1994

A report on a four-month operational trial of a Def Tec Corp OC spray within the Winnipeg Police Department.

Independent Evaluation Report of TASER and AIRTASER Conducted Energy

Victoria Police Department

SGT DARREN LAUR

10 September 1999

An independent comparison of two types of commercially available taser. Written by a law enforcement officer, this report provides comparison details important to the operational use of a taser by police and details each of their perceived strengths and weaknesses.

Injury Risk Assessment of Single Target and Area Fire Less Lethal Munitions

DAVID K DUBAY AND CYNTHIA A BIR

A study to evaluate the risk of injury from less lethal projectiles utilised by the military and law enforcement communities. Tests were conducted using the 3-Rib Chest Structure to determine the severity of blunt trauma using the Viscous Criterion as a measure of the severity of injury.

Interrelationship of Velocity and Chest Compression in Blunt Thoracic Impact to
CHARLES K KROELL, CHARLES Y WARNER AND STANLEY D ALLEN

The report details a study investigating the interrelationships of velocity and chest compression in a series of animal experiments using anaesthetised swine. This is part of a continuing study of thoracic injury resulting from blunt frontal loading.

Joint Non-Lethal Weapons Program: Annual report 1999

Department of Defense

JOINT NON-LETHAL WEAPONS PROGRAM

1999

Report on the year 1999 from the Joint Non-Lethal Weapons program of the Department of Defense.

Less-Than-Lethal Weapons: Reference Guidebook

National Law Enforcement and Corrections Technology Centre, West Region, USA

DR ROBERT J BUNKER

NLECTC-West Occasional Paper 1

July 2000

A reference guide book which organises less-than-lethal weaponry/technology and organisational/conceptual categories. Builds on from 1997 Edition. A collection of over 1,300 references on less lethal weaponry.

Non-Lethal Weapons: Terms and References

Institute for National Security Studies, US Air Force

DR ROBERT J BUNKER

INSS Occasional Paper 15

July 1997

A reference book giving brief descriptions of a large number of less lethal weapons/technologies. Also contains over 600 references for documents relating to less lethal technologies.

Non-Lethal Weapons: Technological and Operational Prospects. Jane's Special

Jane's Information Group

MALCOLM DANDO (EDITOR)

November 2000

A collection of material on the key topics discussed at the Jane's conferences on less-lethal weaponry and technologies.

Oleoresin Capsicum Spray

Canadian Police Research Centre

S/SGT R BONAR

TM-19-94E

April 1994

A report on a three-month evaluation of three types of OC spray product within British Columbia Police Departments. Advantages and disadvantages of each of the types of spray are compared.

Pepper Spray: A Magic Bullet Under Scrutiny

AMERICAN CIVIL LIBERTIES UNION OF SOUTHERN CALIFORNIA

28 September 1993

This report raises questions about the health effects of pepper spray, particularly on mentally ill, asthmatic, obese or drugged people.

Pepper Spray Update: More Fatalities More Questions

AMERICAN CIVIL LIBERTIES UNION OF SOUTHERN CALIFORNIA

June 1995

This report examines 26 fatalities which occurred among people who were sprayed with pepper spray by police officers in the period 1 January 1993 - 1 June 1995.

Pharmacological Evidence for a Set-Point Mechanism in Thermoregulation

JAN FRENS

1976

A report on a laboratory study using goats to obtain evidence about the way the stimulus for thermoregulatory reactions is produced. Capsaicin is used as one of the stimulants in the study.

Plastic Bullet Injuries in Northern Ireland: Experiences During a Week of Civil

J STEELE, S J McBRIDE, J KELLY, C H DEARDEN AND L G ROCKE

1999

This paper details injuries attributed to plastic bullets from the period 8-14 July, 1996 during the "Drumcree crisis". The paper exams the details of a total of 172 injuries from 155 patients in six hospitals.

Projectile-Material Interactions: Stimulants

B JANZON

1997

Article into the use of various flesh simulants when testing projectile material interactions. Concentrates on fragments and bullets.

Report of the Enquiry into the Medical & Toxicological Aspects of CS Part II

HAROLD HIMSWORTH

Command 4775

01 July 1971

A continuation of Part I to include the assessment of evidence relating to the toxicity of CS control agent.

Report of the Enquiry into the Medical & Toxicological Aspects of CS Part I

HAROLD HIMSWORTH

Command 4173

01 October 1969

Investigation of evidence relating to the lasting medical effects, if any, of CS control agent upon persons exposed to CS during or subsequent to its use by the Royal Ulster Constabulary in Londonderry on the 13th and 14th August 1969.

Riot Control Agents - Biomedical & Health Aspects of the Use of Chemicals in Civil

DR BRYAN BALLANTYNE

01 January 1977

This review discusses the use of chemicals in peace keeping operations, their effects, the methods by which potential hazards can be assessed and the health care that may be necessary when chemicals are used by security forces in civil disturbances.

Role of Impact Velocity and Chest Compression in Thoracic Injury

DAVID C VIANO AND VENG-KIN LAU

January 1983

Article into the role of impact velocity and chest compression in thoracic injury. The study explores the relationships between velocity and compression which would be theoretically associated with the level of dissipated energy during thoracic dynamics. Describes a study in which blunt, non-penetrating thoracic impact of prescribed velocity and forced displacement was delivered to the supported thorax of anaesthetised rabbits.

Salivary Cooling, Escape Reaction and Heat Pain in Capsaicin-Desensitised Rats

F OBAL JR, G BENEDEK, A JANCZO-GABOR AND F OBAL

1979

Salivary thermolytic mechanisms as well as escape behaviour and reaction to heat pain were studied in capsaicin-desensitised and control rats exposed to various warm ambient temperatures.

Shape Factor in the Penetration of Intracular Foreign Bodies

ALBERT M POTTS AND JOHN A DISTLER

100: 183-187

July 1985

This paper details a study of the way in which the shape of a missile striking the eye affects the ease of penetration of the central cornea. The study used pigs' eyes as test objects.

Specification for CS Sprays for Operational Police Use

PSDB

T G SHELDON AND DR J TAN

PSDB 2/97

1997

A specification detailing technical requirements for the contents, design and performance of a suitable spray device along with test methods which can be used to determine compliance. It was written to reflect the police operational requirement for an incapacitant spray.

Statement on 2-Chlorobenzylidene Malononitrile (CS) and CS Spray

COMMITTEES ON TOXICITY, MUTAGENICITY AND CARCINOGENICITY OF CHEMICALS IN
FOOD

23 September 1999

A report detailing the conclusions of each of the three Committees regarding the use of CS spray as a chemical incapacitant.

Tests on a Shocking Device - The Stun Gun

O Z ROY AND A S PODGORSKI

July 1989

Technical note detailing tests into the safety aspects of the Stun-Gun. Involves testing on live pigs.

The Biomechanical response of the Thorax to Non-penetrating Impact with

DR GRAHAM COOPER, BRIAN PEARCE, MICHAEL STAINER AND ROBERT MAYNARD

December 1982

This paper describes sternal injury, gross cardiac pathology and cardiac dysrhythmias following non-penetrating impact by a variety of impactors to the sternum of experimental animals. A correlation between injury severity and chest wall displacement is demonstrated and a simple model is developed to predict chest wall displacement if other parameters are known.

The Effect of Capsaicin on Temperature Regulation of the Rat

M CABANAC, M CORMARECHE-LEYDIER AND L J POIRIER

1976

A short summary report detailing a study on rats to determine the effects of capsaicin on their temperature regulation.

The Relative Immunity of the Skin and Cardiovascular System to the Direct Effects

ROBERT A STRATBUCKER AND MATTHEW G MARSH

1993

This short paper summarises some testing of commercially available tasers and stun guns. Both the generalised electronic properties of the devices along with the physiologic effects on human and animal subjects are presented.

The Taser Weapon: A New Emergency Medicine Problem

ERIC KOSGROVE MD

20 February 1985

This paper describes the taser and reviews its effects and ballistic and electrical considerations. Clinical aspects of taser injury are also discussed.