

AIR POWER STUDIES CENTRE

PAPER 38

November 1995

**NON-LETHAL WEAPONS
IMPLICATIONS FOR THE RAAF**

By

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About the Author

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INTRODUCTION¹

Unless you plan your strategy and tactic far ahead, unless you implement them in terms of weapons of tomorrow, you will find yourself in the field of battle with weapons of yesterday.

Alexander de Seversky²

Over the past few years a discussion has emerged on a new class of weapons that are likely to be of increasing utility to defence forces. These weapons have been variously labelled, but for the purposes of this paper will be referred to as non-lethal weapons. The subject of non-lethal weapons can cause controversy as some commentators debate the merits of the search for the 'soft clean kill', and of arming combat forces with equipment that is not designed to support a war fighting capability. The reality is that military forces are increasingly being called upon to do much more than win conventional wars. As governments grapple to find new ways to promote national interests and deal with security concerns, military forces must be able to offer a variety of options. Non-lethal weapons are one means of expanding those options.

The Australian Defence White Paper stresses that the Australian Defence Force (ADF) must be able to deter or defeat any credible armed attack.³ Hence our Services develop capabilities to carry out this prime function. However, the White Paper also places emphasis on the utility of military forces to carry out other national activities such as regional engagement, cementing alliances, supporting global security and supporting the Australian civil community.⁴ Non-lethal weapons are likely to be useful options for all these as well as the direct defence of Australia.

To some degree, the importance of non-lethal weapons stems from the impact of the so-called revolution in military affairs (RMA) which is characterised by fundamental changes to the nature of warfare. Many of the elements of the RMA were demonstrated in the Gulf War when the US-led coalition was able to strike simultaneously at all three levels of war with what were previously considered strategic capabilities.⁵ Indeed these attacks were conducted with precision against key targets, thus minimising collateral damage, including incidental injuries. Today democratic developed nations like Australia are particularly well informed about the effect of combat operations through a very active media. This means that the use of military force must be explicitly linked to political objectives and any such use of force must be done with the least possible loss of lives. The public will expect relatively clean operations: clean in terms of overall lives lost and damage done to

¹ I am grateful to my colleagues at the APSC for the advice and support they have provided with this paper and I would like to acknowledge the particular assistance of the Director GPCAPT John Harvey, Dr Alan Stephens and SQNLDR Jim Walker.

² De Seversky, A., from a speech to the USAF Air University, 28 May 1948, p 5: quoted in Hurst, G. R., *Taking Down Telecommunications*, thesis presented to the faculty of the School of Advance Air Power Studies, Maxwell Air Force Base, Alabama, Air University Press, September 1994, p 41.

³ *Defending Australia: Defence White Paper 1994*, Department of Defence, Australian Government Publishing Service, Canberra, 1994, p iii.

⁴ *ibid*, see Chapters 8, 9, 10 and 13.

⁵ Jablonsky, D., *The Owl of Minerva Flies at Twilight: Doctrinal Change and Continuity and the Revolution in Military Affairs*, US Army War College: Fifth Annual Conference on Strategy, Strategic Studies Institute, US Army War College Carlisle Barracks, May 1994, p 29.

enemy civilians and civilian objects.⁶ With this sort of expectation military planners should have capabilities at their disposal which enable them to match the military force applied with the political objectives, some of which will be strictly limited.

To enable the ADF to consider and develop these types of capabilities, and for the Royal Australian Air Force (RAAF) to employ them effectively, intellectual effort is required to ensure the right options are pursued. Recent publications from the US and Europe have discussed the RMA and the emergence of a number of new issues, which include non-lethal weapons, which will impact on how military forces are likely to fight in the future. To ensure the government has a range of credible options, Australian defence planners must address these issues.

The central theme of this paper is that non-lethal weapons can provide the RAAF with a number of additional air power options and should, therefore, be investigated. This paper will broadly discuss some of the emerging technologies which could be used by military forces. To do this it will consider the fundamental issue of what constitutes a non-lethal weapon, why they are important, the various types of non-lethal weapons that are under development and their relevant to Australia's strategic circumstances. It will also briefly examine some of the issues that deserve greater attention but cannot be fully covered here; these include the questionable legality of some of the weapons, their cost, and doctrinal applications.

What are Non-lethal Weapons?

Defining non-lethal weapons is difficult and complex. Many terms have been used to describe what are now more commonly referred⁷ to as non-lethal weapons. These include the broader terms: non-lethal technologies, non-lethal disabling technologies, disabling technologies, minimum force technology, disabling systems, and similar terms such as: low lethality weapons, low collateral damage munitions, less than lethal weapons and disabling weapons. Some see the very description of 'non-lethal' as a seductive, politically attractive ploy to win support and funding.⁸

Many of these terms reflect the paradox inherent in the very concept that weapons may be self limiting ie. designed not to kill. Weapons are generally used to inflict harm by injuring, killing or destroying. Therefore, placing limits on the effects of weapons which may be used in military operations may not coincide with the requirements of the person being asked to use the weapon. Generally, if military personnel use force to carry out an attack, be it an offensive or defensive operation, then such force should have the greatest possible effect so that the military objective can be achieved. In the case of non-lethal weapons, the intent implicit in the design of the weapon is to limit the damage done to persons or objects being attacked. It is this intention which is a critical factor when trying to define non-lethal weapons.

⁶ *ibid*, p 47. In addition most nations are parties to international humanitarian law treaties which place specific obligation on nations to attack only military objectives, minimise collateral damage and follow other law of armed conflict regulations.

⁷ This is the author's conclusion after a survey of current articles on the subject.

⁸ Aftergood, S., 'The Soft-Kill Fallacy', *The Bulletin of the Atomic Scientists*, Volume 50, Number 5, Sep/Oct 1994, pp 40-42.

One problem with a definition based on intent is that even when the aim is to minimise casualties, deadly consequences are still possible. For example, an attack on an electrical grid may be aimed at disabling the electricity reticulation system rather than killing humans, but if humid-cribs in a hospital are thereby deprived of electricity babies will die. Yet the intent was not to kill those children when the attack took place. An analogy can be drawn with the use of precision guided munitions. Laser guided bombs will not always fall precisely where they are aimed. Any precision guided munition can go astray because of mechanical, technical or human error. However, as in the use of non-lethal weapons, it is the commander's bona fide intent that is important when judging the outcome in a legal sense, not the end result.⁹ When non-lethal weapons are issued for use, the intent of the commander is to reduce the risk of fatal consequences to any opponent, not eliminate the possibility. Therefore, any discussion of non-lethal weapons must recognise the risk inherent in the use of any weapon.

This risk will have to be considered by those planning military operations which utilise non-lethal weapons and military personnel who use non-lethal weapons, but it should not unduly restrict their use of these weapons in appropriate circumstances. The manner in which these weapons are used should be driven by the military objective. Such military objectives always come from the political imperatives of the government. Accordingly, when commanders and their planning staff are considering how to achieve these political ends, the number of options they can offer should be maximised wherever possible so the amount of force necessary can be matched as closely as possible to the overall aim of the operation. These aims can range from monitoring activities with unarmed observers to engaging in aggressive counter offensives in the face of a serious threat to national survival. Non-lethal weapons can assist commanders in this matching.

There is no settled definition of non-lethal weapons. In constructing a definition, I will begin by breaking up the term, first defining 'weapon' and then defining 'non-lethal'. I will then bring these two definitions together. In this paper, 'weapon' is given its standard meaning as being 'any instrument of combat for use in attack or defence'.¹⁰ By extension this encompasses any device or system which can be used either directly or indirectly to destroy or defeat an enemy eg. by food shortage or electrical power failure.¹¹ This definition addresses those systems which can be directed at either people or equipment.

When we look at the term 'non-lethal' there is no standard dictionary definition. The word 'lethal' in the Macquarie Dictionary is defined as 'pertaining to, or such as to cause death; deadly'.¹² In contrast the Oxford Dictionary includes: 'designed to cause death' in its definition.¹³ Therefore, taking the broader Oxford approach non-lethal

⁹ This is evident from Australia's Declaration clarifying the Additional protocols to the Geneva Conventions; see *AAP 1003 – Operations Law for RAAF Commanders*, Air Power Studies Centre, Fairbairn, 1994, para.6.11 and Annex A to Chapter 6.

¹⁰ Dupuy, T. N., Johnson, C. and Hayes, G. P., *Dictionary of Military Terms*, H. W. Wilson Co., New York, 1986, p 229; being similar to the definition in *The Macquarie Dictionary*, The Macquarie Library Pty Ltd., Macquarie University, 1991, p 1977.

¹¹ *ADFP 101 – Glossary of Terms*, Defence Department, Director of Publishing, Canberra, 1994.

¹² *The Macquarie Dictionary*, p 1009.

¹³ *The Concise Oxford Dictionary* (7th Ed.), The Clarendon Press Oxford, 1982, p 1218.

(being the negative of lethal) can be defined as not causing death or not designed to cause death. This therefore restricts our discussion to weapons that are specifically designed not to cause deaths.

Before proposing my own definition I will list some of the many definitions that have already been proposed for the term – non-lethal weapons’:

‘non-lethal weapons disable or destroy without causing significant injury or damage.’¹⁴

‘any instrument which is intended to disable personnel or equipment while avoiding killing people or doing catastrophic physical damage to equipment.’¹⁵

‘non-lethal weapons include nonconventional weapons technologies which disrupt, degrade or destroy (or enhance the ability of other weapons to do so) enemy capabilities throughout the conflict spectrum, and whose intent is to prevent or reduce loss of life or catastrophic destruction of equipment.’¹⁶

‘a system that can incapacitate an adversary’s capability while *attempting* to prevent non-combatant injuries, friendly/adversary casualties, and collateral damage.’¹⁷

‘those technologies “which can anticipate, detect, preclude or negate the use of lethal means thereby minimising the killing of people”.’¹⁸

‘non-lethal weapons are discriminate weapons that are explicitly designed and employed so as to incapacitate personnel or material, while minimising fatalities and undesired damage to property and the environment.’¹⁹

To provide a basis for discussion, I will adapt the last definition listed, which is from the draft US Defence Department Policy on non-lethal weapons. It is broad but specifically ties non-lethal weapons to the explicit intention of minimising deaths. The minor adjustment reflects the concern that such weapons are designed to prevent fatalities but not necessarily undesired damage to property or the environment. Therefore, for the purposes of this paper, non-lethal weapons are defined as:

Discriminate weapons that are explicitly designed and employed so as to incapacitate personnel or material, while minimising fatalities.

¹⁴ Paul Wolfowitz, US Undersecretary of Defense in a March 1991 Memorandum quoted in Aftergood, ‘The Soft Kill Fallacy’, p 40.

¹⁵ Definition of Office of the Secretary of Defense’s Non-Lethal Strategy Group on Disabling Weapons quoted in Hunter, R. C., ‘Disabling Systems and the Air Force’, *Airpower Journal*, Fall 1994, Volume VIII, Number 3, p 43.

¹⁶ Hurst, *Taking Down Telecommunications*, p 31.

¹⁷ Definition from a RAND Study headed by Dr Gerald Frost of non-lethal concepts quoted in O’Connell, E. P. and Dillaplain, J. T., ‘Nonlethal Concepts : Implications For Air Force Intelligence’, *Airpower Journal*, Winter 1994, p 26.

¹⁸ J. & C. Morris quoted in Toffler, A. & H., *War and Anti-War: Survival at the Dawn of the 21st Century*, Little Brown & Co., Boston, p 127.

¹⁹ *Draft Non-Lethal Weapons Policy*, US Department of Defence, from brief ‘DoD Activities in Non Lethal Weapons’, presented by C. Swett, Assistant for Strategic Assessment at Sixth Annual SO/LIC-CD Symposium and Exhibition, Operations Other than War: Challenges and Requirements, Washington DC, December 1994.

This definition means that the non-lethality of the weapon depends on the intention of the designer who produces the weapon, the trainer who trains people on how to use the weapon, the commander who deploys the weapon, and finally the person who uses it. Intentions can of course change and this gives rise to another dilemma. Should the use of these weapons always be restricted to minimise death, or should the flexibility to utilise the deadly potential of the weapons be retained? I would contend that this flexibility should be retained to enable military personnel who may have to utilise the weapons to make the judgement as to how the weapons should be used in a particular scenario. Their use to cause deaths in pursuit of military objectives may, however, have political costs.

Why Non-Lethal Weapons?

Interest in non-lethal weapons over the past few years has been high, as is evident from the number of journal articles that have emerged on the subject. From these writings, a number of important common factors have emerged. These factors are relevant as we try to work out why non-lethal weapons have attracted such interest.

The factors that link discussions on non-lethal weapons are that they:

- a. are designed to minimise injuries but can also be used to minimise damage;
- b. can be used in a variety of security scenarios but would be intended for use primarily in operations other than war, such as peace operations and defence force aid to civil authorities;
- c. should be capable of precision use against military objectives; and
- d. can be designed to incapacitate either permanently or temporarily.²⁰

Given these factors, non-lethal weapons may be an attractive option for future planners who will have an increasingly complex security environment in which:

- a. public interest in the use of military force will be high;
- b. the international media will publicise many of the effects of military operations;
- c. military forces will be used to further national and international interests through operations other than war, particularly peace operations;
- d. legal restraints to minimise incidental injuries and collateral damage become increasingly important;
- e. military resources become scarcer thus demanding the exact application of force to fit particular situations; and

²⁰ WGCdr M. Lax contributed this point which is critical when considering incapacitating infrastructure or equipment that people rely on to live.

- f. sensitivity to casualties on both sides may be high.

It is a combination of these common factors and the new security environment that has led to military interest in non-lethal weapons, particularly since the end of the Cold War. In addition, governments may demand non-lethal options for the pursuit of national interests and, therefore, military commanders at the highest level should be in a position to offer those options.

The Development of Non-lethal Weapons

While non-lethal weapons are primarily a modern invention dating from World War II, there are some early examples of the use of non-lethal technology. These include the use, in ancient times, of smoke to conceal movement of soldiers; and fortifications such as the Great Wall of China. Many early defensive weapons such as moats, shields and armour, and concealment techniques also had non-lethal consequences but their primary aim was to enable a defender to survive so he could bring his lethal weapons into action and destroy his enemy. A modern example is the use of jamming aircraft in an air battle or as a prelude to an air strike. Jamming is not designed to bring deadly force to bear against an opponent but it is used by air forces to defeat or deceive air defences, and is a critical forerunner to many air strikes which may result in enemy deaths. Despite the existence of these types of weapon systems they do not fit the proposed definition of non-lethal weapons, because they are not designed to prevent casualties, and are therefore excluded from the discussion.

Since the early seventies, a number of studies have been conducted in the United States and Britain into non-lethal weapons. These types of weapons were seen as a 'technical fix' to the thorny problem of the non-lethal use of force. Developments in technology led US Congressman James Scheur to report in 1972 that:

We can tranquillise, impede, immobilise, harass, shock, upset, stupefy, nauseate, chill, temporarily blind, deafen or just plain scare the wits out of anyone the police have a proper need to control.²¹

In recent times, discussion on non-lethal weapons has continued as politicians search for strategic options, police battle to bring law and order, and military commanders seek fresh initiatives to win the tactical battle.

To date the use of non-lethal weapons by military forces has been extremely limited. When Agent Orange was used as a defoliant in Vietnam it was believed to be harmless to humans and therefore could be described as a crude form of non-lethal weapon. The intention accompanying the use of this chemical agent was to deprive the enemy of a sanctuary and base of action.²² Since Vietnam, there has been some limited use of directed energy devices to attack military equipment and personnel. For instance, in 1982, the Royal Navy used low energy laser dazzle systems to distract

²¹ Wright, J., 'Shoot Not Kill', *The Guardian*, 19 May 1994, p 43.

²² Hurst, *Taking Down Telecommunications*, p 33.

Argentinean pilots who were attacking their ships.²³ In the Gulf War non-lethal weapons were used to strike key targets and limit incidental injuries.

In November 1990, during the build up to the Gulf War, the US journal *Defense News* reported that an 'influential group of scientists and former government officials' had stated that non-lethal weapons were being developed and could be available for deployment to the Gulf War within weeks. Such weapons included 'electromagnetic pulses to destroy enemy electronics, laser weapons to blind and dazzle enemy sensors, very low frequency sounds to disorient enemy troops, and chemicals designed to weaken or wreck engines and aircraft structures'.²⁴

However, during the Gulf War there were only two public reports of the use of non-lethal weapons. One of these was that low energy lasers (named 'Stingray') were placed on Bradley armoured vehicles and similar lasers (named 'Dazer') were rifle mounted.²⁵ The Stingrays on the Bradley vehicles were designed to detect, track and neutralise the target acquisition system of any threat vehicle. The second and most publicised use of non-lethal weapons was the firing of Tomahawk cruise missiles against Iraqi electrical generation plants.²⁶

The Tomahawk missiles, fitted with Kit 2 warheads which were filled with carbon fibre threads, caused massive short circuits and the immediate shutdown of critical generators. Power supplies were disrupted but the generator plants themselves were not destroyed. One of the air campaign planners, Colonel John Warden, has stated that the intent was 'to defeat Iraq not destroy it'.²⁷ The use of Tomahawk missiles clearly fitted this war aim. Critics on the other hand point to the fact that the use of these 'non-lethal' Tomahawks devastated the civilian population that was otherwise spared the direct effects of the bombing campaign, and in any case the plants were later destroyed with conventional weapons.²⁸

Despite such criticism, the US has continued to develop non-lethal weapons and has worked on a coordinated policy approach on the subject. A draft Pentagon strategy, which was released in early 1992, called for the use of non-lethal warfare as an adjunct to conventional and nuclear war, requiring changes to doctrine, weaponry, training and acquisitions.²⁹

Since 1991, there has only been one other occasion when the US military has actually used non-lethal weapons. This was during its military deployment to Somalia to ensure the safe withdrawal of UN peacekeepers in early 1995. In this case, US Marines had stinger grenades with rubber pellets; wooden shotgun pellets; rubber bullets; beanbags fired from guns; a barricade made from soap and tear gas; and a

²³ *International Defense Review*, 7/1994, p 33; *Directorate of Army Research and Analysis Newsletter*, Issue 2 June 1994, Australian Army Directorate of Army Research and Analysis, Russell Offices, Canberra.

²⁴ *Defense News*, 5 November 1990, pp 1, 37

²⁵ *International Defense Review*, 7/1994, p 33; *Directorate of Army Research and Analysis Newsletter*.

²⁶ Fulghum D. A., 'Secret Carbon-Fiber Warheads Blinded Iraqi Air Defenses', *Aviation Week and Space Technology*, 27 April 1992, p 18.

²⁷ *The Bulletin with Newsweek*, 8 February 1994, p 55.

²⁸ Aftergood, S., 'The Soft-Kill Fallacy', p 42.

²⁹ *Defense News*, 17 February 1992, pp 1, 50.

glue gun which immobilised victims.³⁰ The use of these weapons was highly publicised at the time. It was reported that the Pentagon was testing these weapons in an attempt to validate developing military doctrine on non-lethal weapons.³¹

A draft US Defense Department policy statement on non-lethal weapons was made public in late 1994.³² This statement defined non-lethal weapons, described some general principles relating to their use, and then defined:

- a. missions for which non-lethal weapons should be acquired,
- b. how non-lethal weapons should be employed, and
- c. possible employment objectives.³³

These areas are a useful guide for any ADF policy work on the subject. For the RAAF a knowledge of the application of non-lethal weapons technology will aid future planning for employment of any such weapons.

Apart from the US, the NATO alliance is also reported to have commenced a review of future equipment acquisitions which includes non-lethal weapons.³⁴ The primary aim of the review is to equip the 16 NATO nations for the future, with a particular focus on peace operations. Some of the non-lethal weapons identified for study are blinding lasers and acoustic generators to disable belligerents; airborne fuel-jelling agents for use against aircraft; high power microwaves to disrupt electronic circuitry; and relaxant chemicals to slow troops.³⁵ The question at this point is whether non-lethal weapons are relevant to Australia and the ADF, and if so which technologies should the ADF investigate?

Relevance of Non-lethal Weapons to the ADF

In order to defend Australia and further national interests, the ADF is equipped with a variety of weapons designed to be used from platforms on the sea, land or in the air. Some of these may be used from more than one platform. Our defence planning gives priority to naval, air and highly mobile land forces which are technology intensive.³⁶ Maintaining the technological edge over a range of capabilities is therefore an important component of this strategy. Certain key areas have been identified where Australia will strive to retain a decisive edge. One of these areas is weapons and sensors.³⁷ Non-lethal weapons have the potential to enhance the ADF mission by contributing to the basic goal of any military operation, which is the establishment of a stable and enduring peace after victory has been achieved.³⁸

³⁰ *Defense News*, 27 February 1995, p 28.

³¹ *ibid.*

³² *Draft Non-Lethal Weapons Policy*.

³³ *ibid.*

³⁴ *Defense News*, 11 July 1994, pp 3, 20; 10 April 1995, p 2.

³⁵ *Defense News*, 11 July 1994, p 3.

³⁶ *Defending Australia*, p 22.

³⁷ *ibid.*, p 27.

³⁸ *AAP 1000 The Air Power Manual* (2nd Ed.), RAAF Air Power Studies Centre, Fairbairn, 1994, p 5.

The Defence White Paper describes roles for the ADF. These include: protection of shipping, and offshore territories and resources; air defence; protection of Australian civil and defence assets; and strategic strike.³⁹ Some of these envisage ADF operations on Australian territory. If these operations were carried out in Australia there would be a premium on reducing the risk to any non-combatants who were in the area of operations, and minimising collateral damage to Australian assets. During peace any ADF operation in aid of the civil power could also make use of non-lethal options, providing politically acceptable options for the use of force.

Australia is also a party to many international treaties which place restrictions on the use of military force. One of the most important principles underlying these obligations is the requirement to attack only legitimate military targets, using only such force as is necessary to achieve the military objective while attempting to minimise civilian injuries and damage. Any collateral damage or incidental injuries must be kept to a minimum and proportional to the planned military objective.⁴⁰ Non-lethal weapons will assist with compliance with these obligations.

Apart from the defence of Australia, the White Paper also states that national interests can be furthered by ADF participation in multi-national operations. Peace operations form the majority of such multinational operations and therefore Australia places a high priority on contributing to UN missions.⁴¹ At the lowered end of the peace operations spectrum there is a need for doctrine, training and weapons which allow the ADF to act as an effective peacekeeping force. The weapons needed for these types of missions must be discriminate and highly accurate. If possible, they should also allow a range of responses, commensurate with the threat at the time. These responses should include the ability to use non-lethal force against a threat. Again, non-lethal weapons can play an important role in achieving these objectives.

A case in point was Operation Solace in which Australian soldiers were deployed to assist the US led task force on a humanitarian mission in Mogadishu. The US forces had cayenne pepper sprays available for riot control, but as Australian troops were neither trained nor equipped for such situations, the only non-lethal option was the threat and controlled use of pick-axe handles and tent staves against hostile civilian crowds.⁴² While these low technology options proved successful in the circumstance, more advanced solutions should be explored and utilised if available.

The use of air power in the Bosnian conflict has demonstrated the utility of air forces in peace operations.⁴³ Therefore non-lethal options should interest air planners who may have to prepare for such contingencies. Useful capabilities would include the ability to ground air forces through non-lethal means such as depriving fixed wing aircraft of runways or interrupting the effective performance of aircraft engines

³⁹ *Defending Australia*, p 30.

⁴⁰ *Protocol Additional to the Geneva Conventions of 12 August 1949, and Relating to the Protection of Victims of International Armed Conflict* (Protocol I), Australian Treaty Series 1991, Number 29, Department of Foreign Affairs and Trade, see Parts III and IV generally.

⁴¹ *Defence of Australia*, pp 104-105.

⁴² Kelly, M. J., 'Operation Solace Post Operation Report Legal', (unpublished), Department of Defence, Enoggera, November 1993, p 4.

⁴³ Despite the presence of many thousands of peacekeepers in Bosnia, it was only when NATO air power was fully utilised that the warring parties were forced to agree on a cease-fire which led to the lifting of the siege of Sarajevo in October 1995 and prospects of an overall settlement.

without causing permanent or catastrophic failure. Colonel John Warden has even envisaged a scenario where a city under fire from artillery pieces located near civilian residences or holy shrines could be protected from the air. He has raised the possibility of aircraft dropping a package of liquid metal embrittlement agents on the artillery pieces. The next morning the gunners would face the prospect of their pieces blowing up should they try to fire them.⁴⁴

However, we should recognise that the ADF is structured for the defence of Australia and the demands of peace operations will not influence ADF force development, other than at the margins.⁴⁵ Accordingly any non-lethal options must directly relate to the defence of Australia.

Non-lethal Weapons

The following list of weapons, as described in a variety of open source publications, gives an indication of the technologies being developed and the possible capabilities which may result. These capabilities will then be linked to ADF roles.

Low Energy Lasers. As mentioned earlier, low energy lasers have already been fitted on rifles and armoured vehicles. They were used in the Falklands War to dazzle enemy pilots and were deployed during the Gulf War. These lasers can damage the optical systems of conventional weapons and sensors but also have a direct effect on humans. Lasers can temporarily or permanently blind people. A number of systems are reported to be under further development in the US and UK.⁴⁶

High Power Microwaves. High power microwaves can be used as a directed energy weapon to destroy unshielded electrical systems. These microwaves could penetrate vulnerable sections of aircraft or missiles and disable critical avionics systems such as flight controls, engines, navigation equipment, communications and weapons. The main drawback of microwave systems is the amount of energy required since existing sources with high energy and power density are not compact. US laboratories are continuing research into this technology with a view to targeting computers and communications so that enemy command and control, and situational awareness can be disrupted.⁴⁷

Isotropic Radiators. Isotropic radiators are omni-directional radiators which are designed to illuminate, or bloom, with laser bright intensity causing the same retinal or optical damage as a low energy laser. Isotropic radiators work like powerful flashbulbs. They have simple mechanism whereby explosives are used to compress gas to a plasma at a temperature so high that it becomes incandescent. The method of delivery can range from a hand held grenade to an air delivered bomb.⁴⁸ These

⁴⁴ Warden J., from a paper 'Non Lethal Concepts of Operation', delivered to a COMDEF audience in Washington DC, June 1994, paper kindly supplied by Colonel Warden while he was Commandant of the Air War College, Maxwell AFB.

⁴⁵ *Defending Australia*, p 106.

⁴⁶ Evancoe, P. R., 'Non-Lethal Alternatives: Weighed by Law Officers', *National Defense*, May/June 1994, p 29.

⁴⁷ Tapscott, M. and Atwal, K., 'New Weapons That Win Without Killing on DoD's Horizon', *Defense Electronics*, February 1994, p 44.

⁴⁸ Starr, 'Pentagon Maps Non-Lethal Options', p 34.

weapons can be used in relatively inaccessible areas, like mountains, where directional lasers would be ineffective. There have been reports of possible Soviet use of these weapons in Afghanistan following treatment of Afghans afflicted with various degrees of blindness.⁴⁹ Similar to isotropic radiators are directional radiators which release a substantial amount of energy in one direction creating a single-burst laser effect.

Electromagnetic Pulse (EMP) Generators. EMP has been described as ‘the next great weapon to evolve in modern warfare’.⁵⁰ Initially discovered as a side effect of nuclear tests, the phenomenon has now been extended to non-nuclear generators. Such generators can create an EMP which will disable unshielded electronic systems. A development beam generator with a one gigawatt capacity could be used to develop a line of sight EMP which would knock-out most unshielded electronic devices. Like high power microwaves, communications, computers, navigation and data processing systems would be most affected by such weapons. The current limitations of this weapon are power generation and capacitor storage capability.⁵¹ Press reports indicate that research on this is well advanced and consideration is being given to fitting EMP generators as warheads on USAF air launched cruise missiles.⁵²

Infrasound. Infrasound is a powerful ultra-low frequency sound that can cause nausea, disorientation, vomiting and bowel movements. Very low frequency sound waves can penetrate most platforms and structures. The weapons would have application for crowd control and counter-terrorist operations. The technology is being developed and has a research history of over 30 years.⁵³

Liquid Metal Embrittlement. Liquid metal embrittlement agents can change the molecular structure of metals and alloys. This leads to a catastrophic weakening or failure of those areas affected by the agent. These agents can be applied by a brush spray, a felt tipped marker, or even splashed on. The substance is a clear liquid which leaves little or no residue. Any aerial application would have to utilise an expendable platform, since the spray would invariably coat the delivery vehicle as well as the target.⁵⁴ Development of some agents has been achieved and technical data are available from open sources.

Supercaustics. Supercaustics and supercorrosives are highly active chemical agents which can be used against similar targets as liquid metal embrittlement agents and with similar effects. They also affect organic compounds such as glass, rubber and plastics. As such, they can be used to attack the optics of armoured vehicles, as well

⁴⁹ Evancoe, ‘Non-Lethal Alternatives: Weighed by Law Officers’, p 27.

⁵⁰ Kopp, C., *A Doctrine for the Use of Electromagnetic Pulse Bombs*, Air Power Studies Centre Working Paper No. 15, July 1993, RAAF Fairbairn; see also Kopp, C., ‘EMP – The Emerging Electromagnetic Threat’, *Australian Aviation*, July 1995, p 50.

⁵¹ Evancoe, P. R., ‘Non-Lethal Technologies Enhance Warrior’s Punch’, *National Defense*, December 1993, p 27.

⁵² Fulghum, D. A., ‘ALCMs Given Nonlethal Role’, *Aviation Week and Space Technology*, 22 February 1993, p 20.

⁵³ Evancoe, P. R., ‘Non-Lethal Alternatives: Weighed by Law Officers’, p 29.

⁵⁴ Starr, ‘Pentagon Maps Non-Lethal Options’, p 35.

as rubber tyres of aircraft and other vehicles.⁵⁵ It is possible that supercaustics could also adversely affect asphalt and concrete.⁵⁶

Superlubricants. Superlubricants employ anti-traction technology to render a surface useless by making it slippery. Some polymers and emulsions are suitable for use as superlubricants. These chemicals would have obvious application against airfields and roads. Superlubricants could be applied in a variety of ways, including from an aerial platform. They are susceptible to weather and temperature extremes and must be formulated for specific application. The technology exists today but it is not used for anti-traction purposes.⁵⁷ Any use of superlubricants could be defeated by sand, gravel or bridges for ground vehicles, but clearing runways could be a more difficult proposition.

Superadhesives. Polymer agents can be used as superadhesives to deny use of facilities. They can also be used to 'freeze' personnel and equipment in place. Deployed as a mist from an aircraft the polymer could be sprayed over wide areas or deployed via aerial munitions. This could have the effect of clogging any air breathing engines and fouling air filters for cooling plants such as those used in electric generating plants.⁵⁸ Sticky foam is a closely related agent that can immobilise people. It was reportedly deployed but not used by US forces in Somalia. Sticky foam can be sprayed on people covering them with a glue that stops all movement. It was developed to counter nuclear terrorism.⁵⁹

Combustion Alteration Technology. Combustion alteration technology consists of chemical additives that either contaminate or change the fundamental characteristics of fuel thus degrading the performance of air breathing engines. These additives can be used so that they are taken in through the air intakes of the engines or added to fuel at the source. These chemicals could be sprayed over areas used by aircraft causing instantaneous stoppage of air breathing engines in the area. Similarly, they could be dispersed in front of aircraft and would cause immediate engine failure once ingested.⁶⁰

Electrical Power Disruption Technologies. An electric power disruption munition was first used during the Gulf War in 1991. The technology originated after an accident on the US West Coast when chaff cut power supplies to the city of San Diego in 1985. The weapon uses light, conductive, carbon fibres which wrap around transmission lines and distribution points, to cause a massive short circuit. Even when power is restored the fibres must also be removed because any breeze can result in another short circuit.⁶¹ This weapon can be delivered by cruise missiles, as was the case in the Gulf, or from manned aircraft.

Computer Viruses. Tactical and strategic computer viruses can be used during armed conflict in the same way as they have plagued computer users during peace. As low

⁵⁵ Aftergood, 'The Soft-Kill Fallacy', p 43.

⁵⁶ Starr, 'Pentagon Maps Non-Lethal Options', p 35.

⁵⁷ Evancoe, P. R., 'Non-Lethal Technologies Enhance Warrior's Punch', p 28.

⁵⁸ *ibid.*

⁵⁹ Kiernan, K., 'War Over Weapons that Can't Kill', *New Scientist*, 11 December 1993, p 16.

⁶⁰ Evancoe, 'Non-Lethal Technologies Enhance Warriors Punch', p 28.

⁶¹ Starr, 'Pentagon Maps Non-Lethal Options', p 38.

cost commercial systems become increasingly important to the management of military forces the threat will increase. Today the ability to deny or subvert information may be of more value than physical attacks against an enemy. The threat is further magnified by the ability of viruses to travel through linked computer systems. The use of computer viruses is regarded as part of the information warfare equation and routine virus protection has been the order of the day in the US since at least 1989.⁶² Possible virus threats include 'sleepers' which are designed to be activated when a conflict arises. The proliferation of datanets will make the spread of viruses, including 'sleepers' easier.⁶³ The most likely targets for such viruses are command, control, communications and intelligence systems but they can affect any computer systems which support military activity.

Calmative Agents, Soporifics and Tranquillisers. Calmative agents are drugs which have a sedative effect and can incapacitate through contact or ingestion. Tranquillisers can be regarded as calmative agents. While these sorts of drugs are normally regarded as medication they can be used as non-lethal weapons. Tranquillisers can be used in dart guns, similar to those used with animals, while other calmative agents can be dispersed by aircraft sprays, aerial bursts and dust compounds. These agents can also be dispersed via building ventilation systems and other enclosed places like aircraft cockpits. There are a number of available drugs which can be mixed with dimethyl sulfoxide, which promotes direct absorption through the skin to quickly sedate persons affected.⁶⁴

Visual Stimuli and Illusion. Visual Stimuli and Illusion encompasses a number of possible weapons which are designed to disorient, deceive and disable people. The main technology proposed under this category is the use of high intensity strobe lighting which can create disorientation, vertigo and nausea by affecting the brain's wave patterns. This effect has been referred to as the 'Disco Effect' and there are cases where people in dance venues have suffered epileptic fits.⁶⁵

Non-lethal Projectiles. Rubber bullets have been used by police and military forces for some time and provide a good, proven example of a non-lethal projectile delivered from a dual use weapon, such as a rifle or shotgun. Stun bag (or beanbag) ammunition is another example of this. Another group of non-lethal projectiles are fired from riot guns and grenade launchers. This latter category consists of large slow projectiles which can knock down or disable people or large groups. Another projectile that falls into this category is a non-penetrating, high frequency, acoustic bullet. This acoustic bullet would incapacitate by creating plasma in front of a target which creates an impact wave that produces an impact like a blow from a blunt object.⁶⁶

Electric Stun Guns. Stun guns deliver electric shocks designed to stun but not kill. Some of these guns are already in use by US police agencies. These weapons can disable people at short range but only have a momentary effect. A more advanced technique could involve firing an electrified nylon net to entrap a target. These nets

⁶² Peterson, A. P., 'Tactical Computers Vulnerable to Malicious Software Attacks', *Signal*, November 1993, p 74.

⁶³ Starr, 'Pentagon Maps Non-Lethal Options', p 37.

⁶⁴ Evancoe, P. R., 'Non-Lethal Alternatives: Weighed by Law Officers', p 28.

⁶⁵ Starr, 'Pentagon Maps Non-Lethal Options', p 39.

⁶⁶ Tapscott, M. and Atwal, K., 'New Weapons That Win Without Killing', p 45.

would only shock if the target tried to escape.⁶⁷ This technology could be useful in riot control or where there is a need to capture someone who is in the vicinity of a valuable and fragile asset like an advanced aircraft and the use of conventional munitions could have catastrophic effects.

Non-lethal Weapon Use by the ADF

The non-lethal weapons and associated technologies listed above provide a range of capabilities which could be used by the ADF in carrying out its assigned mission. To illustrate this, I will examine some of the ADF roles and then link non-lethal weapons and technologies to particular air power roles.

Where there is a need to protect shipping, offshore territories and resources, there is likely to be a requirement to defeat maritime surface forces. The use of weapons which could inhibit the engines of these vessels could prove an important adjunct to traditional methods of attacking naval units, especially in time of tension prior to the start of actual armed conflict. Therefore, combustion alteration agents could be useful. These could be dispersed by spray from a stealthy unmanned aerial vehicle thus reducing the risk to friendly forces. Similarly, many modern naval vessels are dependent on computer systems and these could be attacked by EMP bombs, high power microwave weapons and computer viruses. The personnel on the vessels may also be vulnerable to low energy lasers, isotopic radiators, calumative agents, and visual stimuli and illusion.

The ADF must be able to protect Australia's sovereignty by defeating any aerial threat. Counter air operations would be conducted to attain and maintain the desired degree of control of the air. The most effective means to achieve this is to attack an enemy's air defence infrastructure and assets.⁶⁸ While attack from the air is one option, land forces can also play an important role in disabling aircraft and support facilities. The assets which would be targeted by the ADF would include enemy aircraft, air bases and other air defence support facilities. Like naval combat systems, air power is becoming increasingly dependent on sophisticated computer systems, both within the cockpit and in support areas. Attacks against communications, navigation, avionics, and command and control systems by computer viruses, EMP bombs, and high power microwave bursts could be devastating. The aircraft themselves could be attacked by liquid metal embrittlement and supercaustic agents while runways could be rendered useless by superlubricants. In the cockpit, aircrew would be vulnerable to lasers and isotropic radiators which could temporarily blind while drugs could affect performance. Aircraft engines could also be disabled by combustion alteration agents and superadhesives.

For operations within Australia where the ADF must protect civil and defence assets, non-lethal technologies could have an important place as there would be a need to minimise collateral damage. In defending Australian assets, non-lethal weapons, which could be delivered as aerial sprays, may be able to immobilise an enemy's vehicles and then any soldiers could be disabled by a variety of non-lethal weapons discussed above. These weapons could also be employed around vital assets like air

⁶⁷ Starr, 'Pentagon Maps Non-Lethal Options', p 39.

⁶⁸ *AAP 1000*, p 77.

bases where ground defence personnel may need to take particular precautions to protect sensitive objects and infrastructure.

Finally, strategic strike options could be developed utilising non-lethal weapons. An EMP or microwave bomb could have catastrophic effects against an enemy's command and control system, and other systems and infrastructure that support military action. A sleeper virus which is activated within key systems could also have a greater effect than any conventional air strike against the facilities they are housed in. Non-lethal weapons allow strategic and military planners a range of options so that any threat can be met with a measured response. These weapons could be employed in the early stage of a conflict and their use might mean that a full scale war was avoided thus reducing bloodshed and destruction.

Given the uses outlined above there is scope for the eventual acquisition and use of non-lethal weapons for ADF roles associated with the defence of Australia. Once in the ADF inventory, these weapons would also be available for operations other than war. However, many of the technologies on which non-lethal weapons rely are still under development and there are a number of issues which need to be addressed before they become available for military use.

Non-lethal Weapons Issues

Development of Weapons. Many of the weapons discussed above are only possibilities at this stage. Some, however, have already been used by police and military forces and are currently available. Research into those newer weapons is underway in a number of highly classified research facilities, mainly in the US and some parts of Europe. Accordingly, the technology may not be readily available outside those nations. No doubt those nations will wish to retain the advantage of first use so as to retain the element of surprise. On the other hand, legislative and domestic political pressure may force a nation like the US to reveal its non-lethal arsenal and in some cases make it available to allies or coalition partners. In either case, Australia's ability to access the weapons cannot be certain. Therefore, we should look at developing those technologies which are available locally. This would assist the ADF to be self reliant, may reduce the cost of the weapon, and provide the ADF with a valuable new capability.

International Law. There are a large number of international treaties which affect weapons of war. US officials have already expressed concerns that some non-lethal weapons could violate international regulations which control the use of chemical and biological weapons.⁶⁹ In particular, these regulations are contained in the 1975 Biological Weapons Convention and the 1993 Chemical Weapons Convention. This could affect such weapons as liquid metal embrittlements, supercaustics, superlubricants, combustion alteration agents and calmativ agents. Other treaties may also have an impact on the use of non-lethal weapons. During the lead up to the review of the Protocols and Conventional Weapons Convention,⁷⁰ Sweden has called

⁶⁹ *Defense News*, 'DoD Nonlethal Efforts Fuels Fear of Treaty Violations', 26 September 1994, pp 3 and 36.

⁷⁰ 1980 Convention on Prohibitions or Restrictions on the Use of Certain Conventional Weapons Which may be Deemed to be Excessively Injurious or to have Indiscriminate Effects, also known as the

for a ban on the use of all lasers in war. Australia is a party to many of these treaties and any proposal to develop or acquire such weapons will require a detailed legal review to ensure compliance with international law.

Cost. New technologies and the weapons which result are likely to be costly. Research and development is expensive, and if non-lethal weapons are acquired fresh training and procedures will also be necessary. Some weapons may require special facilities and handling. Testing new weapons may also be difficult as environmental concerns increase. If used, the condition of personnel and equipment subject to attack will have to be continually monitored.⁷¹ Despite the utility of non-lethal weapons in particular operations and tactical scenarios, lethal weapons will still be needed as a backup. Non-lethal weapons could be politically costly if they result in unintended deaths or collateral damage. If non-lethal weapons are acquired and deployed for an operation there will be a public expectation (possibly fuelled by an overly enthusiastic media) of few, if any, deaths. If the expectation is not realised the political consequences could be serious.

Other Issues. New doctrine, procedures and tactics will have to be developed to effectively field non-lethal weapons. This will have to cover such things as when the weapons should be used, how Rules of Engagement should be managed, and how effectiveness is measured when there are no bodies to count or destroyed buildings to photograph. In addition, the development of new weapons such as computer viruses may pose a threat to modern societies highly dependent on information systems. Such weapons could be easily transported across frontiers and would be a dangerous threat in the hands of a terrorist or any disaffected group. Some may also argue that the use of non-lethal weapons could encourage violence if opponents know that they will not be killed.

These are just a few of the issues surrounding non-lethal weapons. These issues need to be thoroughly investigated, and their impact analysed, before any policy on non-lethal weapons is settled.

Conclusion

Non-lethal weapons are difficult to accurately define as the term can mean different things to different people. A number of essential characteristics of non-lethal weapons have been described in this paper to provide a framework for discussion. The RAAF has a commitment to leading edge technology. In an increasingly uncertain world, military forces are being asked to do more with less. The more is not just traditional war fighting and preparation, but also the management of a number of diverse security concerns. This can range from drug and immigrant interdiction to providing humanitarian relief to starving millions on the other side of the world. While the ADF does not build its force to deal with such contingencies they do arise and must be dealt with.

Inhumane Weapons Convention. Australia is a party to this treaty and was represented at the Review Conference held in Vienna in September/October 1995.

⁷¹ Sapolsky H. M., *Non-Lethal Warfare Technologies: Opportunities and Problems*, Defence and Arms Control Program Working Paper, Center for International Studies, Massachusetts Institute of Technology, March 1995, p 7.

Searching for new options which have a dual use is one way of providing for the defence of Australia and at the same time acquiring new capabilities which will enable the ADF to carry out other missions. Non-lethal weapons are one possible means by which this can be achieved. There is ample support in Government guidance for this approach. This paper has described some of the technologies and developments which could provide non-lethal weapons for the ADF. It has also canvassed a number of the issues which will impact on any development or acquisition program. The time is now ripe for non-lethal weapons to be placed on the ADF agenda. Military scientists should be researching the possibilities of new technologies, doctrine writers should be keeping abreast of developments, military planners should consider the possible uses, and tacticians should think about how they would employ new non-lethal weapons.