Tomahawk missiles carrying carbon fibres were launched at Iraq for the purpose of disabling electrical powerplants

Playing The 'Killing Fields' Without Killing

To what extent should the RAF incorporate the use of Non-Lethal technologies?

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Non-lethal technologies have the potential to reduce conflict fatalities and the post-conflict reconstruction costs arising from the detonation of conventional, air-delivered weapons. Therefore, "should the RAF embrace non-lethal technology, enabling it to play the 'killing fields' without killing?" This paper examines the viability of employing non-lethal technologies from the air. It discusses typical non-lethal technologies and the arguments for and against their development. It will show that legal constraints and the limitations of standoff associated with air-vehicles restrict their utility. However, from the RAF's perspective, directed energy technology appears to have the greatest potential for employment. Despite technological immaturity and financial constraints affecting its immediate employment, this paper concludes that directed energy technology is worth pursuing, should the MoD be willing to finance its acquisition.

"I have killed in my lifetime. There are rules to justify the carnage. But the fact remains, you've killed a man. It's not a nice sight. If there is another answer, an alternative, why wouldn't you use it?"[1]

Many commentators viewed the conflict phase of Operation IRAQI FREEDOM (OIF) as an effective example of effects-based operations (EBO) and the UK MoD's ethos continues to shift from an equipment-based defence policy towards an 'effects' and capability-based approach. However, despite Service Chiefs' rhetoric and emphasis on the need to embrace an effects-based ideology, the House of Commons Defence Committee (HCDC) publicly criticised the MoD's acquisition of the full range of capabilities required to execute EBO. The HCDC stated that 'the MoD has only "begun to develop" capabilities to provide a range of options other than having to resort to traditional attritional warfare methods [and they were] disappointed at the apparent lack of progress in developing

capabilities to provide non-kinetic options'.[2] As 'the ultimate application of EBO might involve only the discrete or limited use of destructive force', particular areas of the Committee's concern included a failure to enhance information warfare capabilities and the need to embrace non-lethal technologies for use across the spectrum of conflict.[3]

The Commander-in-Chief Strike Command's (C-in-C HQSTC) vision is to deliver *'precise campaign effects, at range, in time.'*[4] HQSTC's current offensive weapons inventory lacks a non-lethal element, despite this element's potential for providing an effect without causing kinetic destruction. Consequently, the aim of this paper is to examine whether an inventory of air-deliverable, non-lethal weapons (NLW) is a viable proposition and to assess the validity of the Committee's criticisms when viewed through an 'air lens'. This paper will concentrate on the viability of NLW employment from current and future offensive fixed-wing aircraft, including UAV/UCAVs;[5] it will not cover information warfare or the use of NLWs from rotary platforms. Finally, in accordance with NATO policy, this paper will assume that NLWs would be deployed in tandem with lethal alternatives, creating a complementary force package.[6]

Definition of NLWs

The UK defines NLWs as 'weapons explicitly designed and employed to incapacitate personnel or material while minimising fatalities and undesired damage to the property and environment'.[7] NATO expands this definition by stating NLWs should have 'a low probability of fatality or permanent injury'[8] and the US Department of Defence (DoD) adds that 'NLWs employ means other than gross physical destruction to prevent the target from functioning . . . are intended to have relatively reversible effects on personnel or material [and] they affect objects in subjective ways within their area of influence.'[9]

The lead department for the development of US non-lethal policy is the Joint Non-Lethal Weapons Directorate (JNLWD). They class a 'non-lethal chemical weapon as one that incapacitates 98% of the target population while causing fewer than 0.5% fatalities.'[10] Similar figures apply across the spectra of NLWs and while it is accepted that NLWs are not *intended* to kill, the aforementioned definitions accept that a minimal number of fatalities is acceptable during their employment. However, it is the expectation of fatalities that creates academic concerns with the term 'non-lethal'. Critics describe the term 'non-lethal' as a 'euphemism and an oxymoron'[11] as the term raises public expectation in the capability of these technologies. Although other terms have been considered appropriate,[12] the term non-lethal 'represents the intent of the user which is neither to kill nor harm permanently.'[13] Therefore, should NLWs be developed apace, the public must be informed that NLWs are not the 'silver bullet' and there is a distinct likelihood that deaths will occur from their use. These semantics could pose the French a problem as they define NLWs as 'an instrument or means of attack or defence whose direct effects do not lead to death'[14]; should fatalities occur following French NLW employment, they could be viewed as totally unacceptable in the eyes of a critical French public.

Non-lethal capabilities

There is a broad misconception that NLWs are a recent phenomenon. Although NATO and US Policy did not formally recognize non-lethal weaponry until the 1990s, NLWs have existed for nearly a century. 'Tear gases were first synthesized in 1848 [and] were used in both lethal and non-lethal forms during World War I.'[15] The US released defoliants during the Vietnam War in order to increase the vulnerability of an enemy who used the jungle canopy for cover and concealment. Although they were not intended to cause fatalities directly, defoliants had a detrimental effect on the environment, contrary to current definitions. Additionally, US aircraft released 58kg cluster bombs as delivery vehicles for CS.[16] In 1991, carbon fibres were released from US cruise missiles in order to shutdown Iraqi electrical power plants. Generator outputs were halted and no damage was caused to the sites.[17]

Kinetic Energy (KE)

KE NLWs include rubber/plastic bullets, baton rounds, water cannons and dual-use lethal/non-

F-35 Joint Strike Fighter

US aspirations include an integral or podded version of a laser for use on the F-35

lethal guns that can fire 'beanbags'. The dual-use lethal/non-lethal guns are currently fielded in Afghanistan while water cannons and rubber bullets have been used in Northern Ireland and Korea.[18]

Barriers and Entanglements

Barrier and entanglement technologies are intended to stop entry to installations or immobilise moving or stationary vehicles. Typical examples are the 'Stingers' used by US police forces and a Boat Trap Entanglement System (BTES). During testing, a BTES canister was 'dropped from a helicopter in front of a vessel. [Subsequently], an X-shaped net [was] deployed and propelled into the path of a target vessel.'[19]

Electro-Shock

Electro-shock technology utilises an electrical discharge to immobilise either a person or vehicle. A number of police forces operate the anti-personnel 'Taser' and Sky-Marshals in the US, Middle East and Europe are alleged to possess this technology as a means of ensuring greater safety in defending against potential hijackers.[20]

Acoustic

The aim of acoustic weaponry is to project high-intensity sound in order to repel or disable personnel at a distance or to drive personnel out of a facility. The Long Range Acoustic Device (LRAD) has been acquired by the US Marines for use in Iraq and there are claims it was used in Afghanistan to draw terrorists from caves.[21]

Directed Energy (DE)

DE technology directs electro-magnetic energy in order to produce its effect. This classification will be further sub-divided into three classifications:

1. *High Power Microwave (HPM).* HPM technology has the ability to disrupt electronic circuits, enabling it to 'stop vehicles by . . . [disabling] their onboard computers'.[22] A recent article indicates

the feasibility of fitting HPM devices on Storm Shadow, cruise missiles and UAVs.[23] In an anti-personnel Mode, HPM technology is used to heat a victim's body to about 55°C. The USMC are developing a vehicle-borne prototype with future intentions of installing it on aircraft to operate in an 'area-clearing' Mode.[24]

2. *Non-Nuclear Electro-Magnetic Pulse (EMP)*. EMP technology is also capable of targeting electronics. It was tested with mixed results at the Los Alamos National Laboratory in 1993 when its potential for disabling electronics was demonstrated by '[the disabling of] privately owned automobiles [located] 300 metres from the test site.'[25]

3. *Laser*. Lasers can be utilised in either an anti-personnel or anti-material Mode. A Mobile Tactical High Energy Laser demonstrated an impressive anti-material capability by shooting down an artillery shell in flight[26] and Boeing are developing an Airborne Tactical Laser (ATL) for scheduled employment on a C130 in 2006/07. Initially designed to counter Intermediate-Range Ballistic Missiles, the ATL has the potential to stop a vehicle or disable targets akin to radio towers or antennae — it is not designed to destroy buildings.[27] US aspirations include an integral or podded version for use on the F-35.[28]

Riot Control Agents (RCA) and Malodorants

RCAs are irritants deployed with the intent of defusing crowd hostility; their effects are designed to disappear within a short time.[29] Malodorants are affectionately known as 'skunk bombs' and have been used in the US to prevent the occupation of vacant buildings. However, UK research into malodorants has halted due to a lack of technological advances in this field.[30] The main criticism of RCA employment is a lack of standoff from the target area — air assets could prove a key player in resolving this problem.

Biochemical Incapacitating Agents

Typical anti-material biochemical capabilities include microbes that increase the viscosity of fuel or chemicals that act as supercaustics, supercorrosives or embrittlement agents. These agents are designed to render either equipment or fuel ineffective in a combat situation.[31] In anti-personnel roles, biochemicals could be used as calmative or sleep agents. Incapacitating chemicals were used during the Moscow theatre siege in 2002 and this incident will be covered later. Finally, sticky foams are 'polymers that can be used to immobilise [a person], yet allow them to breathe'; the USMC deployed this technology to Somalia although it remained unused.[32]

Combined Technologies

A typical example of a combined technology is sticky foam laced with an RCA or 'electrical projectiles that use a capacitor to store an electrical charge within a bullet that is released when it hits the target person'. The former is currently available while the latter, a combination of kinetic and electrical capabilities, is under development.[33]

Summary

Barriers and entanglements are optimised against relatively slow target sets and would be ideally suited for deployment from rotary platforms vice the generally faster, fixed-wing platforms. As electro-shock capabilities require use in extremely close proximity to the target, it is unrealistic to expect this technology to be deployed from any airborne platform. However, recent US research implies that RAF 27mm projectiles could be adapted to deploy biochemical agents or RCAs in an airburst Mode[34] and this will be discussed in greater detail, alongside KE, DE and acoustic technologies.

The NLW debate

Trusedell remarked that 'NLWs would seem to have more particular utility in special operations — especially where there is concern about civilian lives — rather than the main battlefront. Particularly when ensuring non-lethality is the key factor (eg protection of food convoys to refugees), where forces are involved in operations where they personally are not directly threatened (eg hostage-taking situations), where the public is already wary of involvement in a particular conflict (eg Bosnia), these weapons must play an important role.'[35] This view is typical of commentators who support the development of NLWs based on the premise that Western military involvement

Images of the Highway of Death led to a public perception of unnecessary human suffering and calls for a ceasefire . . . and adversely affected coalition targeting plans and the eventual attainment of US objectives

will generally be in Operations Other Than War. However, since Trusedell's article, UK forces have 'intervened' in Kosovo, Iraq and Afghanistan where non-lethal technologies would have proved useful in providing the effects required of a medium or high-intensity conflict. DE technologies could have enabled UK forces to disable mobile forces or neutralise command and control (C2) facilities and surface-to-air missile (SAM) radars. RCAs, biochemical agents and acoustic technology could have been used to disrupt or disable enemy land forces thus enabling Allied forces to take vital ground. Therefore, the relevance of NLWs is not restricted to OOTW but includes the 'main battlefront'.

Combatting the 'CNN Effect'

The 'CNN Effect' is the result of an 'unwritten expectation that military operations conducted by democracies . . . will involve as little bloodshed as possible'.[36] Consequently, any media images highlighting civilian deaths could impact adversely on the continuation of a campaign plan. In 1991, the bombing of a dual-use bunker and air-raid shelter in Baghdad resulted in 200-300 civilian deaths. The resultant media coverage forced extensive coalition PR efforts across the political-military spectra in order to protect coalition cohesion. Coalition targeting plans were also affected, as the impetus moved away from leadership and other targets in Baghdad. Eventually, images of the 'Highway of Death'

A Harrier GR7 of No 20(R) Squadron armed with Maverick air-to-surface missiles (AHB RAF)

The RAF's offensive inventory consists solely of kinetic weapons and these tend to offer the choice of doing nothing or killing

led to a public perception of unnecessary human suffering and calls for a ceasefire. The domino effect of public discourse ran from the shelter bombing to the 'Highway of Death' and adversely affected coalition targeting plans and the eventual attainment of US objectives.[37] Had DE NLWs existed in 1991, the coalition would have been able to dislocate the Iraqi C2 network with a concomitant reduction in civilian casualties, thus countering or delaying the 'CNN Effect'.

During recent conflicts, opponents have used urban areas for cover, concealment and movement. The increased use of the urban environment is down to two major factors. Firstly, compared to 1990 figures, the world's urban population is expected to triple by 2025, potentially making it difficult to bypass sprawling urban areas in manoeuvre warfare. Secondly, enemies will continue to lure coalition forces into urban areas in order to reduce the effectiveness of the coalition's technological superiority. This occurred in Somalia when 'warlords sought to fight US forces in the alleys . . . where combat was reduced to rifle against rifle.'[38] OIF highlighted Krulak's '3-block war' where warfighting, peacekeeping and humanitarian assistance operations occurred in adjacent neighbourhoods and equipment was also placed in urban areas for 'sanctuary' purposes. During OIF, a satellite antenna was positioned in a car park to the rear of a Western media facility and used to broadcast Iraqi propaganda. Following much consternation and conscious of the proximity of Western journalists, coalition commanders elected to destroy the antenna with a Maverick

missile that contained a small, explosive warhead. Fortunately, there were no casualties. Had the commanders possessed a non-lethal alternative, for example DE technology, they would have undoubtedly taken this option.[39] These examples highlight the potential of non-lethal technology in reducing the strategic impact of kinetic weapon use in areas of collateral concern.

'Filling the gap'

Alexander writes that 'assuming . . . no utopian intervention will take place in the foreseeable future, humans will continue to engage in conflict, just as they have in the past and are today'.[40] As a consequence of the Strategic Defence Review and New Chapter, the UK could be involved in protecting its national interest and acting as a 'force for good' over an indefinite period. While EBO requires inter-governmental assistance in resolving conflicts, military intervention is often seen as the 'necessary evil' once the diplomatic, information and economic lines of activity are perceived to have failed. Currently, the RAF's offensive inventory consists solely of kinetic weapons and these tend to offer the choice of doing nothing or killing.[41] Therefore, NLWs offer an alternative to conventional weaponry and could reduce the probability of enemy armed forces' and civilian deaths, thereby reducing the probability of conflict escalation. Recent events in Iraq have shown the value of 'air presence' in defusing volatile situations, as hostile crowds have dispersed and insurgents have halted attacks following the arrival of 'fast-air'. Should these 'shows of force' have failed, conventional firepower was the sole remaining option and could have resulted in civilian deaths with associated, far-reaching, political ramifications.

NLWs could be used to demonstrate intent to a belligerent, thereby providing airmen and politicians with a 'sort of halfway house in the decision-making process.'[42] The use of non-lethal technology to attack a strategic target would demonstrate intent for military involvement, with a reduced probability of civilian deaths. Once the intent, willingness and capability to engage in conflict had been demonstrated, the belligerent would be left with two choices — do nothing and face further punishment from NLWs and/or lethal means or refrain from the activity that preceded the need for military intervention. Although Saddam Hussein appears to have had no intention of surrendering in 2003, the option of launching a cruise missile, armed with a DE warhead, against his strategic targets would have enabled the coalition to partially dislocate Saddam from his forces giving him time to reconsider his enemy's real intent. Conversely, critics 'feel the use [of NLWs] reflects a lack of political resolve and weakens the effectiveness of the military by not producing the physical effects necessary to punish an aggressor [and that NLWs] encourage politicians to micromanage military commanders and places the lives of military personnel at risk.'[43] Assuming that NLWs can deliver the desired effect, an aggressor should not have to be subjected to kinetic effects and the potential loss of life in order to feel 'punished'. The loss of an enemy's ability to communicate intent to his forces, or the use of incapacitating agents to fix enemy forces thereby increasing their vulnerability for subsequent attack, could be viewed as sufficient 'punishment' in certain scenarios. Moreover, air assets — UAVs and missiles in particular — offer commanders the opportunity to deliver effect at range without placing a large number of forces at risk. It could also be argued that politicians are already able to micromanage military commanders as a consequence of recent improvements in standoff capability and precision weaponry. During 1991, political consternation arising from Tornado losses during low-altitude operations resulted in their elevation to medium altitude for the remainder of the conflict.[44] This is a prime example of political micromanagement, as medium-altitude operations were in direct opposition to RAF tactics and doctrine and the aircraft were subsequently less effective. However, extensive US Suppression of Enemy Air Defence support reduced the risk to aircraft operations at medium-altitude and the acquisition of Precision Guided Munitions (PGMs) and laser designation pods quickly reversed the initial decline in RAF effectiveness. Therefore, it is likely that NLWs will simply form another part of the politicization process

RAF Tornado GR1s armed with Paveway laser-guided bombs departing from Muharraq, Bahrain, during Operation GRANBY, 1991 (AHB RAF)

During 1991, political consternation arising from Tornado losses during low-altitude operations resulted in their elevation to medium altitude for the remainder of the conflict

and military commanders must ensure their personnel are not placed at increased risk simply because NLWs are contained in the inventory.

Critics of NLWs also argue their use would increase the probability of conflict escalation. The use of RCAs to quell a peaceful demonstration following a misinterpretation of the crowd's intent would undoubtedly antagonise the target population and create further problems for occupying forces. A compounding argument is that 'in interventions which begin with an intent to employ only NLWs, forces may quickly face the necessity of employing lethal weapons where no actual intervention would have occurred if it were understood that lethal systems would be used.'[45] However, as stated previously, this paper assumes that NLWs would be deployed in tandem with a lethal alternative, thereby demonstrating intent to deploy lethal means should they be required.

Another area of concern is the temptation for pre-emptive use of a NLW prior to the attainment of international consensus for military action. The US Council of Foreign Relations (CFR) discussed this eventuality by '[suggesting] that weapons targeting electrical systems might be a solution to the clear need for means short of invasion and

A Tornado GR4 armed with Storm Shadow missiles. Storm Shadow could be modified to carry HPM/EMP technology

It is imperative that the temptation to continually use a non-lethal capability for destroying enemy infrastructure be guarded against and that pre-emptive non-lethal options should be given the same considerations as those required for the employment of kinetic effect

destruction [in order] to discourage state tolerance or support terrorist activities'.[46] The use of a Storm Shadow fitted with HPM/EMP technology is the type of device that could pose this temptation, although the legality of an 'electronic invasion' could well be challenged in the international forum. It is also imperative that the temptation to continually use a non-lethal capability for destroying enemy infrastructure be guarded against and that pre-emptive non-lethal options should be given the same considerations as those required for the employment of kinetic effect. However, despite the aforementioned counter arguments, 'most conflicts pose a fear of escalation [and] the use of NLWs in the early stages of a conflict *may* reduce the risk of escalation, [thereby giving] diplomacy a chance to work'.[47]

Credibility on the world stage

An increasing amount of military action results from Western calls for interventions in humanitarian crises. However, 'when lethal force instead of non-lethal force is used by those who have come in the name of 'humanity', the complexion of the situation changes.'[48] If an intervening force's attempts to quell unrest by employing NLWs were to prove unsuccessful, an escalation into the kinetic realm

in order to save friendly forces and civilian lives *should* have more justification in the international arena. Conversely, critics 'feel the development of non-lethal technology will trigger unwanted and unintended involvement in parts of the world experiencing turmoil.'[49]

Reduced post-conflict reconstruction costs

The astronomical cost of rebuilding a nation following the extensive use of kinetic force is evident in Iraq.[50] Following the use of carbon-fibres against Iraqi power stations, 'the Iraqis restored commercial power considerably faster than had been anticipated'.[51] This could have been a result of inadequate pre-conflict analysis or the fact that the cessation of electrical distribution by non-lethal means aided in reducing the reconstruction effort, as components had not been completely obliterated and structures permanently weakened by kinetic effect.[52] Critics expand this argument further by stating that NLWs had lethal consequences, as public services were drastically affected by the loss of power, resulting in increased health hazards and a lack of potable water.[53] However, these critics fail to comprehend that the desired effect was the cessation of electrical distribution and this could have been achieved by lethal or non-lethal means. Had conventional means of attack been employed, the potential for civilian deaths and physical damage at the time of weapon impact would have been greater and the security of the infrastructure would have been placed in greater jeopardy. Therefore, this criticism should relate to the coalition's targeting policy rather than the inadequacy of NLWs. Finally, while this example highlights the potential benefit of reduced reconstruction costs resulting from NLW employment, an extremely relevant lesson is the need for planners to identify potential second and third order effects when targeting NLWs: this is an essential facet of EBO.

Targeting biochemical weapon facilities

In 1994, the US Defence Secretary issued a memorandum detailing a need for HPM weapons in order to "disable or destroy weapons or weapon development/production processes, including suspected weapons of mass destruction."[54] Concerns at this time included a suspected, buried and hardened chemical weapon research facility that was deemed impenetrable to all means of attack vice a nuclear strike. Furthermore, the potential destruction of illegal Iraqi biochemical production facilities was perceived as difficult to achieve with conventional weapons, as the release and dispersion of biochemical agents following kinetic attack would be difficult to control. Therefore, the benefits of developing DE weapons in order to halt the production of biological and chemical weapons is an obvious benefit, particularly if one considers the devastating effects of the nuclear option. However, some critics believe that NLWs should not be developed at all despite their applicability in countering the 'greatest evil', that of WMD, and this leads to the specific criticisms of NLWs.

Criticism of specific non-lethal technologies
KE weapons

During tests on KE rounds, it was claimed that '56% of rounds could not reliably hit a [50cm diameter] circular target . . . from 23 metres away' and that 'ricochets from hard objects posed substantial hazards to friendly bystanders at near range'.[55] An associated problem with inaccuracy is an increased risk of fatalities and deaths have resulted from KE employment.[56] The increased muzzle velocities of aircraft cannons, combined with a reduction in accuracy caused by the standoff inherent with a strafing delivery of KE projectiles, would render this technology more lethal and potentially less discriminate. Therefore, KE technology will be discounted from further discussion.

Acoustic

Acoustic weapons operate by inducing pain in a victim. 'When [a victim is] subjected to [acoustic attack], possible changes can occur in the pulse and in breathing . . . followed by extreme nausea and . . . disorientation . . . Medical evidence suggests that infrasound at certain frequencies can cause long-term damage on internal organs at short range, with perhaps uncontrollable effects, such as epileptic seizure, and bowel spasms'.[57] This causes potential human rights issues as innocent victims may be subject to 'cruel and inhumane treatment' contrary to Article 5 of the Declaration

A Tornado GR4 of No 617 Squadron; the muzzle of the 27mm Mauser cannon carried by this aircraft can be seen ahead of the squadron badge (AHB RAF)

Despite the potential for adapting strafing rounds for delivering RCAs, the only fixed wing asset forecast as capable of firing a cannon is the GR4

of Human Rights, particularly if operated in 'towns where there are crowds and buildings, the sick and elderly, as well as children, [as they] are likely to be in the weapon's range'[58] [59] However, the greatest restriction to the airborne employment of acoustic technology is the requirement for minimal standoff from a target to ensure the appropriate weapons effects.[60] If a UAV were utilized to deliver acoustic effect, its proximity to potential targets would cause it to become a 'sitting duck' to small arms fire. Missiles could be employed to deliver this effect although the damage mechanism must be constantly placed on the target for a prolonged period in order to force personnel to move: this is probably an unlikely use of missile technology. Finally, as the accuracy and efficiency of this technology would be further reduced by atmospherics, land forces would be more appropriate in directing acoustic effect, particularly in an urban environment. Therefore, acoustic technology is discounted for the remainder of the paper.

DE weapons

A US serviceman who was exposed to HPM effects during testing remarked that "the skin gets extremely hot and people can't stand the pain, so they have to move".[61] HPM therefore requires the victim to select an exit route and if unable to move, the victim would suffer extreme pain and possibly agonising death. Dr Robert Becker, a specialist in electromagnetic effects, claims that other side effects of HPM include retinal bleeding, disorientation, temporary paralysis and loss of memory.[62] Consequently, there are concerns that HPM technology infringes human rights, although the USAF claims that 'in many cases, [an HPM] effect can be generated covertly with no collateral

structural or human damage'.[63] This raises the question of 'discrimination' in HPM employment, although the ability to accurately direct the energy is still under development.

A distinct advantage of DE weapons is their characteristic for employment at range from a target, although atmospherics, obscurants and smoke can reduce their effectiveness.[64] HPMs have been employed at ranges in excess of one kilometre[65] and airborne lasers are often used at ranges in excess of 10 kilometres for designation purposes. It is predicted that future airborne lasers would have the potential to attack an aircraft-type target at ranges of 30-155 miles.[66] Research on the effective range of EMP technologies has failed to uncover recent assessments but it is assumed to be similar to HPM technology. Therefore, based on potential advances in energy direction techniques and the benefits associated with standoff from a target area, DE weapons show significant potential for airborne employment.

RCAs and malodorants

It is likely that trained enemy forces would be equipped with respirators, thus countering the effects of RCAs and potentially, malodorants. Consequently, the utility of RCAs lies at the peacekeeping end of the conflict spectrum, although 'the effect of CS on a civilian in a poor state of health [could] be terminal, even under strict clinical conditions.'[67] Once employed in open areas, RCAs have the potential to drift downwind, affecting the local populace; this occurred in Tucson 'after tear gas used in a training exercise [on a USAF base] was blown over a local shopping plaza triggering numerous calls to the emergency services'.[68] These detrimental effects worsen if RCAs are concentrated in buildings, forming potentially lethal doses. Consequently, RCAs should be targeted against personnel in open areas, reducing the potential for harmful concentrations.

During weapon employment, airmen would be required to consider the meteorological effects on agent dispersion in order to reduce the risk of fatalities among bystanders. This would be difficult to assess from height and should there be a zero-tolerance of fatalities, it would be unwise to employ RCAs from the air. Additionally, despite the potential for adapting strafing rounds for delivering RCAs, the only fixed-wing asset forecast as capable of firing a cannon is the GR4.[69] It is unlikely that financial resources would be expended on equipping a single aircraft type with such a capability, as pressure could be placed on the GR4 as the platform of choice for deployments on peacekeeping missions, placing a potentially unacceptable burden on the Tornado Force. Although RCAs could be delivered by adapting current bomb bodies or by designing new, smaller munitions, another problem is the ability of an airman to assess when to deliver the effect. Co-located land forces are currently the only means of assessing a crowd's mood and intent, and the elapsed time between identifying a crowd's 'trip-point' and resultant chaos could be very short. Even in an era of Network Enabled Capability, the timeliness of air-deliverable RCA could not be guaranteed. Consequently, it would be wiser to properly equip land forces rather than expending resources on equipping aircraft with this capability.

Biochemical incapacitating agents

Gurr argues that the employment of 'sticky foam' could result in a 'risk of asphyxiation or suffocation if . . . ingested [and that] victims [would also be placed] in a vulnerable position.'[70] The standoff capability inherent with airborne platforms would reduce the accuracy and affect the dispersion of 'sticky foam' and it is unlikely that forecast delivery platforms would be able to generate the quantity of foam typically required for a task. A major concern with biochemical incapacitating agents arises from the increased vulnerability of an incapacitated enemy following NLW employment. The Geneva Protocols state that a person is '*hors de combat*' if '[he is] incapacitated by wounds or sickness, and therefore is incapable of defending himself' and 'should not be made the object of an attack'.[71] NLWs are unlikely to cause any external wounds and the ability of a lethally armed attacking force to identify an enemy's inability to defend himself or surrender as a result of NLW-induced 'sickness', would be markedly reduced during the 'fog of war'.[72] This combination of non-lethal and lethal effect on the battlefield rightly concerns the critics of NLWs although

the ability of this technology to *incapacitate* a terrorist makes these agents attractive in an era of asymmetric warfare and insurgency. Therefore, incapacitating agents will be carried forward with DE weapons for further discussion, commencing with the legal issues detailed in the Laws of Armed Conflict.

The legal issue

The main counters to the development of biochemical incapacitants are the Chemical and Biological Weapons Conventions (C/BWC), whereas the development of DE technologies faces greater opposition from the Geneva Protocols.

Additional Protocol I to the Geneva Convention details the regulations for the methods and means of warfare. Articles 35 and 36 state that weapons are not to cause 'superfluous injury or unnecessary suffering . . . cause widespread, long term and severe damage to the natural environment . . . [Additionally], signatories 'of the convention [are obliged] to determine whether [the employment of a new weapon] would, in some or all circumstances, be prohibited by [the standing] protocol or by any other rule of international law applicable to the High Contracting Party.'[73]

Article 48 subsequently highlights the requirement to discriminate between the civilian population and combatants during targeting[74] whereas the Martens Clause states that weapons 'that are abhorrent to the public conscience may be prohibited' based on the principles of international law, humanity and public conscience.[75] In the UK, the Joint Doctrine and Concepts Centre (JDCC) performs this legal analysis, assesses the likelihood of future changes in the law and their effect on the future utility of a weapon.[76] In completing this task, it is imperative that NLWs are not viewed as different to traditional weaponry and the scrutiny they undergo during research and development (R&D) should be rigorous enough to ensure the aforementioned legal principles are considered in addition to potential medical and technical issues.[77]

Unnecessary suffering relates to the physical harm caused by the weapon and its enduring psychological effects. The International Committee of the Red Cross (ICRC) attempted to quantify superfluous injury and unnecessary suffering (SIrUS) and recommended consideration of the following four criteria in assessing a weapon as unsuitable:

1. [Causing] specific disease . . . abnormal physiological state . . . permanent disability and disfigurement

2. [Causing a] provable mortality of more than 25%, or hospital mortality of more than 5%

3. [Causing] Grade-3 (very large) wounds

4. [Causing of] effects that are not treatable by conventional methods of surgery.'[78]

The SIrUS criteria were based on conventional weapons effects but have an element of 'applicability' to NLW design. Coupland argues that one of the major obstacles in furthering the acceptability of NLWs would be the difficulty in treating a victim whose symptoms were unrecognisable.[79] HPM technology is claimed to 'disorientate people . . . [and have] a permanent detrimental effect on [their] internal organs'[80] whereas the purpose of an incapacitating agent is to alter the psychological state of an individual, creating little observable physical evidence to infer a cause of injury. In order to further 'guide the acquisition of information [with] the task of quantifying human suffering and pain',[81] the JNLWD has set up a human-effects-advisory-panel (HEAP). However, this is a national institution and it is imperative that its work is used in producing a clear mandate, issued by a globally accepted body, concerning the subjective rather than objective amount of disability or incapacitation that is acceptable in warfare. Currently, the SIrUS does not cater for the development of the wide range of NLW capabilities, despite their potential for reducing suffering in Modern warfare.

User intent could also be considered in assessing the legality of a technology and it could be argued that this criterion is already recognised in the use of lasers. Lasers with a primary purpose of blinding, fall foul under the first and fourth SIrUS

criteria and are also prohibited under international law. However, incidental or collateral blinding as a result of their use in guiding PGMs or attacking optical systems is not prohibited.[82] Lasers are being designed to possess a rheostatic capability, enabling their use at low powers in order to dazzle personnel and their use at higher powers in an anti-material role. Consequently, laser systems will possess sufficient power to blind and indeed kill personnel and the 'proof of purpose' of the equipment will lie with the weapon designer and airman in ensuring the weapon will not be used to blind instead of destroying a victim or object, thereby demonstrating its use for legal means. International lawyers could find this distinction difficult to justify and it is conceivable that high-powered lasers could be incorporated into an extension of the existing conventions prohibiting the total use of lasers in an anti-personnel Mode, while still permitting their use against material — the outstanding issue would then be the requirement to discriminate and act proportionately. This issue could also apply to EMP or HPM techniques, once their true capabilities and potential side effects are realised.

The use of an incapacitating agent during the Moscow Theatre Siege of 2002 created serious concerns about the utility of incapacitating agents for military purposes. ICRC research estimates that injuries caused by a Kalashnikov result in a 20% probability of mortality while the use of the agent in Moscow resulted in a 17% mortality rate.[83] Detractors of NLWs assessed 'this level of mortality [to] be expected, and that genuinely non-lethal chemical weapons [were] beyond the reach of current science.'[84] It is unlikely the agent had undergone sufficient assessment prior to its employment, but the Russian authorities were no doubt concerned about the potential loss of life should they employ traditional measures in an attempt to free the hostages. The Russian conundrum was the need to use a minimum dose of agent in order to achieve the necessary effect on the terrorists, mindful of the potentially detrimental effect on the hostages who varied from the young-and-weak to the old-and-sick.[85]

The Geneva Convention does not detail an acceptable amount of environmental damage. However, the 1977 Environmental Modification Convention (EMC) prohibits weapons and techniques from having 'widespread (several hundred square kilometres), long-lasting (months) or severe (serious or significant disruption or harm to human life, natural and economic resources or other assets) environmental effects as the means of destruction.'[86] The use of caustics, corrosives, coagulants or liquid-metal-embrittlements could cause localised damage to the environment but it is unlikely they would cause effects of the magnitudes restricted under the EMC due to the limited payload expected of present and future capabilities. Conversely, the legality of sticky foam has been challenged under the auspices of the Montreal Protocol on Substances that Deplete the Ozone Layer[87] and biological agents could cause significant disruption to human life if spread by a national or natural water supply. However, the BWC and CWC place more significant restraints on the use of biochemical means in warfare.

The 1972 BWC outlaws lethal and non-lethal variants whereas the 1993 CWC prohibits the use of all chemical agents as a 'method of warfare' while permitting the use of RCAs for law enforcement and domestic riot control purposes.[88] The deployment of RCAs to Iraq for coalition peacekeeping and riot control situations has caused consternation among some commentators, as the coalition is employing RCAs outside of national boundaries. However, they are performing the domestic duty of maintaining law and order in Iraq and the German government intends to utilise this interpretation of the convention by equipping their forces in Kosovo with RCAs.[89] The US also appears to be planning a breach of the CWC in seeking to purchase riot control grenades for 'controlling counterinsurgencies and other tactical missions . . . outside [of] the law enforcement exception permitted by the CWC.'[90] This raises the dilemma of either enforcing treaties or amending them in order to utilise the technological advances and potential reductions in fatalities associated with NLW employment.

The CWC and BWC both permit research into

biochemical technologies for peaceful purposes. Therefore, an increased realisation of the potential utility of biochemical agents in the military environment should occur as technology matures. Perhaps unsurprisingly, the US is a vocal advocate of treaty amendments and Human Rights Legislation strengthens their case, as states have a responsibility to employ less grievous methods if they exist in order to preserve human life. The 1990 UN Basic Principles on the Use of Force and Firearms by Law Enforcement Officials endorsed this requirement by stating that *'governments . . .should develop a range of means as broad as possible . . . including the development of non-lethal incapacitating weapons . . . with a view to increasingly restraining the application of means capable of causing death or injury to persons.'*[91] As a consequence of the misalignment of the various international treaties, it appears ironic that a state is forced to justify potentially saving lives with NLWs in order to forge treaty amendments when current international law places less restriction on the taking of lives by lethal means.[92]

There is also a continued ethical and moral abhorrence of biological and chemical weapons and the UK government advocated the invasion of Iraq based on the perceived threat of these weapons: this appears to strengthen the case for the status quo. The ICRC criticises calls for treaty amendments and voiced their opinion sin 2003:

'In the history of warfare there has been a line in the sand drawn which is an attempt to keep out of the battlefield anything that involves toxicity on humans . . . The danger of the advances in technology that we're seeing now is that it might tempt us to step over that line.'[93]

The ICRC believes that all advances in technology eventually result in their detrimental use against humans and other commentators voice fears that their proliferation could lead to greater repression of individuals by a 'nanny' state.[94] A further critique is that diversification of biochemical technologies will result in an increased probability of their use by rogue states and terrorists, adversely affecting global security. Duncan, however, scoffed at the prospect of a non-lethal arms race by stating that:

'A non-lethal arms race would probably not be initiated by rogue nations who oppose the US since their desire would be to develop weapon systems to kill US citizens and to destroy US property rather than preserve life and refrain from property destruction.'[95]

Although this statement majors on the perceived US aversion to casualties that was highlighted during the Vietnam conflict, recent kidnappings and media coverage highlight the potential of NLWs in enabling the capture, rather than the killing of US troops. Furthermore, international terrorism is an increasing threat to global security and al-Qaida, in particular, has extensive financial resources and support from a number of rogue states. Imagine the US public's response to the capture of an armed convoy, the members of which had been incapacitated by a biochemical agent and were then paraded on the world's media.

Although international law does not remain constant, the impetus for amendments follow 'once a practice has obtained a degree of regularity and is accompanied by a belief among nations that it is obligatory'.[96] The opportunity to highlight the capabilities of incapacitating agents exists in the sphere of civil peace enforcement and riot control, although treaty amendments would be required to facilitate the further development of this class of technology. Although optimists are confident that further development will make these agents more predictable and hence more useable, skepticism concerning their actual capabilities was evident post the Moscow incident and the prospect of biochemical proliferation poses a real threat to global stability; these are strong arguments in countering the calls for treaty amendments. Although Human Rights Conventions call for restraint in causing death or injury in conflict and the HEAP is a positive move towards a realistic assessment of SirUS, the worldwide distaste for chemical and biological weapons further supports the need to maintain the status quo for the foreseeable future. This argument was further compounded in Mar 2003, when the UK Defence Secretary stressed that the UK would adhere

strictly to the CWC.[97] This substantially reduces the prospects of increased resources for R&D of biochemical incapacitants. As demonstrated, the military employment of biochemical agents is a legal quagmire that is unlikely to be resolved in favour of NLWs and this technology will be discounted for the remainder of the paper. Consequently, DE technology is the sole remaining option for further discussion.

The legal imperatives during targeting are the need to discriminate and act proportionately. Critics of NLWs argue that the seduction of non-lethality may result in a widening of rules of engagement (ROEs) with a reduced emphasis on discrimination between civilians and combatants, particularly in areas of urban terrain. Proportionality requires 'that . . . military action [should] not cause collateral damage or incidental injury which is excessive in light of the expected military advantage'.[98] Therefore, DE weapons designers must ensure they can focus the damage mechanism in order to reduce the probability of damage to neighbouring civilians, equipment or property.[99] The Iraq Wars demonstrated an increase in precision that lowered the political acceptability of incidental injury and collateral damage and it should be expected that DE NLW employment would reduce this threshold even further. Imagine the public outcry should an EMP/HPM device cause a failure of life-saving equipment in a nearby hospital or the disruption of a nearby hub of an international banking system. Consequently, the current UK collateral damage matrix, used to assess the likelihood of civilian casualties resulting from kinetic weapon effects at the time of weapon impact,[100] would be inappropriate for NLWs. Each potential target would need to be analysed in greater depth, placing a greater strain on the intelligence community and potentially slowing down the time-sensitive-targeting process. Rather than the relatively simple question: *"how close is the neighbouring building and how many personnel live/work there?"* the questions must include: *"how close is the building, who lives/works there, what electrical systems are resident and what would be the consequence should these systems be affected?"* Advocates of EBO should be asking these questions as a matter of course, but DE weapons should not be added to the RAF inventory of weapons before their true capabilities and limitations are fully understood. If deployed prior to reaching full maturity, DE weapons could face the prospect of being classed as 'dirty' weapons, similar to the chemical weapons of World War I.

There are concerns that DE technologies would only be permitted for use in an anti-material role and that discrimination and proportionality would dictate the scope of their employment. Also, DE technologies would be adversely affected by atmospherics and this would require the maintenance of a lethal alternative should the weather in potential theatres of operation preclude their employment. However, as the focusing of laser energy is forecast to improve markedly,[101] lasers possess the greatest potential for operations across the broad spectrum of conflict whereas EMP/HPM technologies would probably have greater utility in medium or high-intensity conflicts. Duncan stressed that the Laws of Armed Conflict were 'permissive in nature'[102] and there are currently few restrictions to developing this technology, particularly in comparison to other non-lethal technologies. Moreover, DE technology has the potential to satisfy the UK's Human Rights obligations of reducing the number of deaths in a variety of scenarios and is recommended for incorporation into HQSTC's inventory of offensive capabilities.

Further consideration relating to the development and employment of NLWs

The HCDC observed that 'it remains . . . more an art than a science to judge what kinetic or non-kinetic activity will produce a particular effect'.[103] Once employed, NLWs will also pose difficulties with the measurement of their effectiveness (MOE). The traditional means of Combat Assessment[104] will have less utility and the MOE will require an extensive use of Electronic and Measurement-and-Signals Intelligence (ELINT & MASINT) platforms. For example, should a DE weapon destroy an enemy C2 system, an increase in mobile telephone usage from the area may indicate system degradation. Constant assessment would be required to confirm the enduring effectiveness of an initial attack and

coalition support would be required to ensure the availability of the full complement of assets required to achieve this task.[105] Fortunately, UK Defence Policy foresees coalition operations as the future *modus operandi* for UK forces although, should coalition support be unavailable, a lack of an autonomous UK capability could lead forces to revisit targets with repeated non-lethal or even lethal strikes, thereby reducing the operational effectiveness of a deployed force. If possible, the UK should look to expand their MOE capabilities in order to avoid an over-reliance on coalition partners, although this will come at significant cost.

However, Duncan argues that 'commanders will employ only those weapons they feel comfortable using. For most commanders, the comfort level for lethal weapons systems is much higher than the comfort level for NLWs.'[106] This observation related to the use of RCAs and incapacitating agents, but also applies equally to DE weapons. It is unlikely that realistic training could demonstrate DE effects at first-hand and the education of commanders on the capability of NLWs would be the only solution. This would involve the removal of the cloak of secrecy that envelops new NLWs and potentially reduces the advantage that would come with surprise should these weapons be employed against an adversary. However, General Zinni used this situation to his advantage in Somalia by publicising the potential use of NLWs: this 'psychological ploy intimidated potential Somali adversaries and gave the US military a positive public image at home and abroad'.[107] Truesdell correctly prophesised that 'training for the use of NLWs . . . is moving into uncharted territory that must be defined as planners proceed with the programme development. Ideally, routine training for the use of NLWs should be based on doctrine and be fully integrated into combined arms training.'[108] The JDCC should be responsible for producing doctrine that enables the effective employment of NLWs and once the doctrine is understood, front-line commands should be responsible for continuing the education process. If the education process is not carried through from the concept to the employment phases, the hurdle of advancing on a 'dazed' vice smouldering enemy would not be overcome and NLWs could become an expensive 'white elephant' during all-arms combat.

Operational planners must not be exposed to 'situations where a soldier who uses lethal force when he has had immediate access to NLWs becomes liable to answer in court'.[109] Each situation will require complementary capabilities and it is imperative that politicians do not restrict commanders by insisting NLWs are employed against every target. Assuming targeteers comply with international law, commanders must be given the freedom of choice and furthermore, it is essential in-theatre ROEs reflect this option.

The UK must be prepared to defend its own assets against potential NLW counterattack. Consequently, potential countermeasures must be identified during NLW development. Equipment hardening is likely to be prohibitively expensive as the UK continues to engage in expeditionary operations.[110] Consequently, UK assets will be vulnerable to the proliferation of these technologies although potential adversaries are also likely to face difficulties in financing and developing these technologies. Open sources have identified potential countermeasures against millimetre-wave technologies[111] and further advances in countering DE technologies may offset the advantages proffered by these weapons. However, another advantage of continued NLW development is the knowledge of likely effects and the ability to recognise when under DE attack by an adversary. NATO policy discusses the necessity for robustness in combating potential countermeasures but supports continued R&D of non-lethal capabilities if they offer the opportunity of gaining a distinct military advantage.[112] Saddam Hussein employed smoke and GPS-jammers in order to defeat the laser designation of PGMs and GPS-guided weapons respectively, but he was unable to protect all his valuable assets and counter the coalition's technological edge and military advantage. However, the cost of maintaining this technological edge increases the pressure on decreasing defence budgets and the future role of NLWs is one that policy must dictate.

Current policy

The US and NATO produced coherent policies for NLWs in 1996 and 1999 respectively. Comparatively, UK doctrine incorporated an unspecific and superficial approach to NLWs prior to 2001 and there was no direct mention of non-lethal technology in 'British Defence' or 'Air Power Doctrine,' despite its applicability in executing the Manoeuvrist Approach. However, recent publications, including the 'UK Joint Vision', the 'Joint High Level Operational Concept' and the draft version of the 'Future Air and Space Operational Concept' refer to the utility of NLWs across the spectrum of conflict.[113] Despite this emphasis, there is still no dedicated NLW policy and there are no formal staff requirements in place for air-deliverable NLWs. This situation gives the impression that the UK has no desire to advance in this field, particularly from an air perspective. However, the major factor affecting NLW development is the level of funding required for R&D and the UK's ability to progress in this field is dwarfed by US resources and intent.

The US has increased funding for NLW research from $25 million in 2003 to $44 million in 2004-2005. Moreover, it is proposed that the USAF alone will receive $15.5 million for research into HPM technology in 2005, implying that the technology is worth significant investment. Furthermore, the CFR has called for an increased funding of NLW development to the sum of $300 million in 2005, although this remains an unlikely proposition.[114] While the US can afford to invest in a number of disparate NLW programmes, the UK would struggle to compete, as its R&D budget is approximately 10% of its US counterpart.[115] Consequently, despite the UK's desire to research numerous capabilities, the financial resources are inadequate and the UK may need to identify niche capabilities for further work. From an air perspective, this paper recommends the development of DE capabilities for use primarily during medium or high-intensity operations, although DE technology is unlikely to have a dual use, civilian-military capability, further increasing the burden on the MoD's declining budget. However, the UK should participate in combined programmes in order to exploit emerging DE capabilities, notably with the US, as it is likely they lead the field in developing these technologies. The ATL is an ideal opportunity for collaborative development at reduced financial risk, as US aspirations for this technology include its integration onto the US version of JCA. Additionally, HPM/EMP weapons appear to be beyond the concept stage and could enable the RAF to deliver strategic effect with a reduced number of adversarial fatalities.

Conclusion

The broadcasting of images depicting the death and destruction caused by conventional weaponry is oft considered publicly and politically unacceptable and there are calls for an increased use of non-lethal technology in order to reduce bloodshed and reduce the financial burden of post-conflict reconstruction. A semantic debate will continue to ensue about the term 'non-lethal' as these weapons have and will continue to cause fatalities for the foreseeable future, be it as a consequence of the initial delivery of the effect or as a second or third-order effect. However, NLWs have utility across the spectrum of conflict and have the potential to deliver an appropriate effect with a reduced probability of fatalities.

While a number of non-lethal capabilities have utility from a land perspective, the majority do not appear to be suited to aerial delivery, particularly in an era of reduced spending when there is a constant requirement to justify the benefits of new weapons in offering the 'tactical edge'. A major problem with the aerial delivery of NLWs is a lack of accuracy, primarily due to the standoff inherent with the air environment. Furthermore, land forces are the most applicable means of employing RCAs, even in an era of NEC when aircraft tasking and reaction times should be markedly reduced.

The legal debate presents a dichotomy of interests. While Human Rights Conventions clamour for reduced fatalities, the BWC and CWC prohibit the use of biochemical agents in conflict. Despite calls for treaty amendments to facilitate further biochemical development, potentially saving more lives, the UK's policy is one of strict compliance and there remains a global

distaste of the use of biochemical technologies in warfare. DE technologies face scrutiny over the causing of unnecessary suffering and the principle of discrimination. The temptation to use this technology either indiscriminately or pre-emptively would be a major concern and must be resisted. Additionally, DE technology places increased demands on the intelligence community, particularly during the targeting and combat assessment phases of NLW employment. However, the merits of DE technology outweigh the negative aspects and despite relatively slow progress in its development over the past decade, it appears to pose the only viable alternative to conventional air-deliverable capabilities, albeit with potential restrictions on its use arising from atmospheric effects to possible constraints on its use in an anti-personnel role. Therefore, in considering the claims of the HCDC through an 'air lens', technological immaturity combined with a lack of resources probably explains the MoD's apparent lack of progress in developing NLWs.

In order to realise the true potential of air-deliverable DE technology, future UK funding priorities, collaborative ventures, doctrine and action must reflect both the intent of the HCDC and the MoD's emergent policy on NLWs. However, it is likely the UK will continue to be hampered by a lack of financial resources, particularly in comparison to the US and potential restrictions on the use of DE technology highlight the need to maintain precision-guided, lethal alternatives. Therefore, can the MoD *afford* to embrace the advantages of DE technology while there is a simultaneous requirement to maintain elements of lethality? In making this decision, perhaps MoD policy should attempt to reflect the true cost of human life.

Bibliography

Books

Cohen, E and Keaney, T. (1993), Gulf War Air Power Survey Summary Report (US GPO)

Dando, M (1996), A New Form of Warfare: The Rise of Non-Lethal Weapons (Trowbridge, Redwood Books Ltd)

Lewer, N ed. (2002), The Future of Non-Lethal Weapons: Technologies, Operations, Ethics and Law (London, Frank Cass Publishers)

Lewer, N & Schofield, S (1997), Non-Lethal Weapons: A Fatal Attraction? (London, Zed Books)

Rappert, B (2003), Non-Lethal Weapons as Legitimizing Forces (London, Frank Cass Publishers)

Pamphlets

Bobb, J L Maj, (2002) Non-Lethal Weaponry: Applications to C-130 Gunships (Alabama, Maxwell Air Force Base)

British Air Power Doctrine, Third Edition – AP 3000 (1999), Ministry of Defence (Norwich, HMSO)

Finn, C ed. (2003), Effects Based Warfare (London, The Stationery Office)

Joint Doctrine and Concepts Centre (2001), British Defence Doctrine – Joint Warfare Publication 0-01 (Shrivenham, JDCC)

Joint Doctrine and Concepts Centre (2001), The UK Joint Vision (Shrivenham, JDCC)

Joint Doctrine and Concepts Centre (2004), The Joint High Level Operational Concept (Joint Doctrine Disk; JDD/06 May 04)

Sizemore, F R Lt Col (1996), Airpower, Non-Lethal Weapons, and Future National Security Policy (Alabama, Maxwell Air Force Base)

Thomas, M R Maj (1998), Non-Lethal Weaponry: A Framework for Future Integration, (Alabama, Maxwell Air Force Base)

Truesdell, A (1996) The Ethics of Non-Lethal Weapons (Camberley, Strategic and Combat Studies Institute)

Articles

Aftergood, S (1994), 'The Soft-kill Fallacy', Bulletin of Atomic Scientists, Sep 1994, pp. 40-45

Alexander, J (2002), 'An Overview of the Future of Non-Lethal Weapons'

in Lewer, N ed. The Future of Non-Lethal Weapons. Technologies, Operations, Ethics and Law (London, Frank Cass Publishers)

Alexander, J B (1996), 'Shoot, But Not to Kill', Janes International Defense Review, 6/1996, pp.77-78

Alexander, J B (1996), 'Non-Lethal Weapons Demand Expands as Mission Changes' National Defense, March 1996, pp.34-35

Anderson, G W Col (1996), 'There's a Better Way', Armed Forces Journal, July 1996, p.15

Barrie, D/Flottau, J (2004), 'Directed Effort', Aviation Week and Space Technology, 11 Oct 04, p.52

Davis, M (1994), 'How to Win Wars Without Actually Killing', Asia-Pacific Defence Reporter, April-May 1994

Edwards, R (2000), 'War Without Tears: Should 'Non-lethal'

Chemical and Biological Weapons be Allowed?' New Scientist, 16 Dec 2000, pp.4-5

Edwards, R (2000), 'Rubber Bullets Miss More Than They Hit', New Scientist, 16 Dec 2000, p4-5

Edwards, R (2000), 'War Without Tears: Should 'Non-Lethal' Chemical and Biological Weapons be Allowed?', New Scientist, 16 Dec 2000, pp.4-6

Evancoe, P (1994), 'Tomorrow's Weapons of Choice', Military Technology, 6/94, pp.68-71

Fulghum, D A (1993), 'ALCMs Given Non-Lethal Role', Aviation Week and Space Technology, 22 February 1993, pp.20-21

Fulghum, D A (1992), 'Secret Carbon-Fiber Warheads Blinded Iraqi Defenses', Aviation Week and Space Technology, 27 Apr 1992, pp.18-19

Fulghum, D A (1992), 'US Weighs Use of Nonlethal Weapons In Serbia if UN Decides to Fight', Aviation Week and Space Technology, 17 Aug 1992, pp.62-63

Fulghum, D A (1993), 'EMP Weapons Lead Race for Non-Lethal Technology', Aviation Week and Space Technology, 24 May 1993, p61

Gurr, N J (1997) 'Non-Lethal Weapons: Lifting the Lid on the Issue of Human Rights', International Journal of Human Rights, Vol 1 No 4 Winter 1997, pp. 1-17

Heal, C (1997), 'Making not breaking the Rules', Janes International Defense Review, 9/1997, pp.77-80

Herbert, D B (1999), 'Non-Lethal Weaponry: From Tactical to Strategic Applications', Joint Force Quarterly, Spring 1999, pp. 87-90

Klaaren, J W & Mitchell, R S (1995), 'Nonlethal Technology and Airpower: A Winning Combination for Strategic Paralysis', Airpower Journal, Special Edition 1995, pp.42-51

Kokolski, R (1994) 'Non-lethal Weapons: a Case Study of New Technology Development', SIPRI Yearbook (New York, Oxford University Press)

Lewer, N (1996), 'Non-Lethal Weapons – A New Dimension', Bulletin of Arms Control, No 23, September 1996, pp.1-4

Linder, J B (1996), 'A Case for Employing Non-Lethal Weapons', Military Review, October 1996, pp.25-29

Lorenz, F M (1996), 'Non-Lethal Force: the Slippery Slope to War', Parameters, Autumn 1996, pp. 52-62

Metz, S (2001), 'Non-Lethal Weapons: A Progress Report', Joint Force Quarterly, Spring/Summer 2002, pp.18-22

Morocco, J D (1993), 'Pentagon Faces $88-billion Cut', Aviation Week and Space Technology, 22 February 1993, p22

Morton, J S (1998), 'The Legal Status of Weapons that Blind', Journal of Peace Research, Vol 35, No. 6, (Sage Publications: London), pp. 697-705

Mueller, J (1995), 'The Perfect Enemy', Security Studies, Autumn 1995

O'Connell, E & Dillaplain, J T (1994), 'Non-Lethal Concepts: Implications for Air Force Intelligence', Airpower Journal, Winter 1994, pp.26-33

Rappert, B (2001), 'Scenarios on the Future of Non-Lethal Weapons', Contemporary Security Policy, Vol 22, No. 1, (Frank Cass: London), pp. 57-82

Reitinger, K C Col (1998), 'New Tools for New Jobs', Proceedings, Apr 1998, pp. 37-40

Rosenborg, B H (1994), 'Non-Lethal Weapons May Violate Treaties', Bulletin of Atomic Scientists, Sep 1994, pp. 44-45

Stanton, M Lt Col (1996), 'NonLethal Weapons: Can of Worms', Proceedings' November 1996, pp.58-60

Stanton, M Lt Col (1996), 'What Price Sticky Foam', Proceedings' January 1996, pp.58-60

Wright, S (2001), 'Special Report: Non- Lethal Weapons', New Scientist, 11 Aug 2001, pp. 10-13

Zinni, A & Ohls, G (1996), 'No Premium on Killing', Proceedings, December 1996, pp.26-28

Accessed via Internet
Air Force Research Laboratory (2002), Success Story: Directed Energy Directorate Tests the Boeing Advanced Tactical Laser Demonstrator

http://www.afrl.af.mil/successstories/2002/emerging_technologies/02-de-02.pdf accessed 14 mar 05

Boeing, Advanced Tactical Laser

http://www.rocketdynetech.com/dataresources/AdvancedTacticalLaser(ATL)AdvancedConceptTechnologyDemonstration.pdf accessed 14 Mar 05

Coppernoll, M A (1998), The Non-Lethal Weapons Debate

http://www.aquafoam.com/Coppernoll.pdf accessed 4 Mar 05

Coupland, R M and Meddings, D (1998) Weapons: A Question of Health

Summary of a seminar on Contemporary Arms Control and Disarmament held on 23 September 1998

http://216.239.59.104/search?q=cache:nvMx49TBz-cJ:www.geneva-forum.org/Reports/salw_vol1/19980923.pdf+Superfluous+Injury+and+Unnecessary+Suffering+%22ICRC%22+filetype:pdf&hl=en accessed 1 Mar 05

Davison, N and Lewer, N (2004), Bradford Non-Lethal Weapons

Research Project: Research Report No 5, (University of Bradford)

http://www.bradford.ac.uk/acad/nlw/research_reports/docs/BNLWRPResearchReportNo5_May04.pdf accessed 8 Feb 05 [Provided links to: Arkin, W (2004), 'The Pentagon's Secret Scream: Sonic Devices That Can Inflict Pain – or Even Permanent Deafness – Are Being Deployed', Los Angeles Times, 7 Mar 2004; Coupland, R M (2003), ' "Calmatives" and "Incapacitants": Questions for International Humanitarian Law Brought by New Means and Methods of Warfare with New Effects,' Presented at 19th Workshop of the Pugwash Study Group on the Implementation of the Chemical and Biological Weapons Convention, Oegstsgeest, Netherlands, 26-27 April 2003.]

Davison, N and Lewer, N (2004), Bradford Non-Lethal Weapons Research Project: Research Report No 6, (University of Bradford)

http://www.bradford.ac.uk/acad/nlw/research_reports/docs/BNLWRPResearchReportNo6_Oct04.pdf accessed 10 Nov 04 [Provided link to: Alaimo, C. (2004) D-M Colonel Apologizes for Tear-Gas Accident. Arizona Daily Star, 17 September 2004. Available at: http://www.dailystar.com/dailystar/relatedarticles/39340.php]

Duncan, J C (1998), 'A Primer on the Employment of Non-Lethal Weapons', Naval Law Review

http://www.au.af.mil/au/awc/awcgate/law/nonlet2.pdf accessed 10 Nov 04

Fravel, J D, Joint Program Office for Special Technology Countermeasures (2000),

Brief on Non-Lethal Countermeasures, 21 Mar 2000

http://www.dtic.mil/ndia/nld4/fravel.pdf accessed 7 Mar 05

Freinberg, Rayment (2004), 'Microwave Gun to be Used by US Troops on Iraq Rioters', Telegraph, 30 Jan 05

http://www.telegraph.co.uk accessed 31 Jan 05

Guyatt, D (2004), Non Lethal Death

http://www.deepblacklies.co.uk/non_lethal_death.htm accessed 30 Nov 2004

House of Commons Select Committee on Defence - Fifth Report (23 June 2004)

http://www.parliament.the-stationery-office.co.uk/pa/cm/cmselect/cmdfence accessed 30 Nov 04

Ibrugger, L (2000), Special Report: Emerging Technologies and their Impact on Arms Control and Non-Proliferation

http://www.nato-pa.int/archivedpub/comrep/2000/at-275-e.asp accessed 31 Jan 05

Isenberg, D (2003), 'US Chemical 'Non-Lethal' Weapons in Iraq: A Violation of the Chemical Weapons Convention?' Occasional Papers on International Security Policy, No 44, March 2003

http://www.basicint.org/pubs/Papers/BP44.htm accessed 31 Jan 05

Jontz, S (2002), 'Military Testing Future Additions to Non-Lethal Weapons Arsenal', Stars and Stripes Sunday Magazine, 22 December 2002

http://cndyorks.gn.apc.org/caab/articles/nonlethalweapons.htm accessed 24 Nov 04

Kennedy, H (2004), 'Lightweight Shotgun Deploys to Afghanistan', National Defense Magazine

http://www.nationaldefensemagazine.org/article.cfm?Id=1344 accessed 8 Dec 04

Klotz, L & Furmanski, M & Wheelis, M (2003), Beware the Siren's Song: Why Non-Lethal Incapacitating Agents are Lethal

http://microbiology.ucdavis.edu/faculty/mwheelis/sirens_song.pdf

accessed 10 Nov 04

Levine, S & Montgomery, N (2002), Non-Lethal Weapon Human Effects

http://www.dau.mil/pubs/pm/pmpdf02/July2002/lev-ja2.pdf accessed 24 Feb 05

Lyell, Lord (1997), Non Lethal Weapons: Draft General Report

http://www.nato.int accessed 31 Jan 05

Marcus, J (2004), US Told to Boost Non-Lethal Arms

http://news.bbc.co.uk/1/hi/world/middle_east/3489824.stm accessed 9 Feb 05

McClelland, J (2003), The Review of Weapons in Accordance with Article 36 of Additional Protocol I

http://216.239.59.104/search?q=cache:lcDvseRvMPQJ:www.icrc.org/Web/eng/siteeng0.nsf/htmlall/5PXET2/%24File/irrc_850_McClelland.pdf+Superfluous+Injury+and+Unnecessary+Suffering+%22ICRC%22+filetype:pdf&hl=en accessed 1 Mar 05

Morales, F (2000), Non-Lethal Warfare

http://www.southbaymobilization.org/homepage/Nonlethal_warfare_2000.pdf accessed 10 Nov 04

NATO (1999), NATO Policy on Non-lethal Weapons

http://www.nato.int/docu/pr/1999/p991013e.htm accessed 31 Jan 05

Pearson, G S & Dando, M R ed. (2003), 'Strengthening the Chemical Weapons Convention: First CWC Review No 4 – The Danger to the Chemical Weapons Convention from Incapacitating Chemicals', March 2003

Accessed via Department of Peace Studies, University of Bradford,

http://www.bradford.ac.uk accessed 10 Nov 04

Rappert, B (2004), A Framework for the Assessment of Non-Lethal Weapons

http://www.ex.ac.uk accessed 31 Jan 05

Scott, M (2003), 'Progress in Directed Energy Weapons',

US DoD Weapons Systems Technology Information and Analysis Center, Vol 4 No 1, (Spring 2003)

http://wstiac.alionscience.com/Newsletters/Vol4Num1.pdf accessed 14 Mar 05

Tirpak, J A (2002), 'Attack at the Speed of Light', Air Force Magazine, December 2002

http://www.afa.org/magazine/dec2002/1202attack.pdf accessed 14 Mar 05

Toje, A (2004), Time to Change the Rules? The EU Response to WMD and Weapons of Minimal Destruction Proliferation, (University of Cambridge)

http://www.eupolicynetwork.org.uk/toje1.pdf accessed 10 Nov 04

US DoD (1996), Policy for Non-Lethal Weapons, 9 Jul 1996

http://www.dtic.mil/whs/directives/corres/pdf/d3003_070996/d3003p.pdf

accessed 7 Mar 05

Anonymous (2002), US Military Scores Laser Success

http://news.bbc.co.uk/2/hi/technology/2407807.stm accessed 8 Feb 05

Anonymous (2003), The Weapons of Bloodless War

http://news.bbc.co.uk/1/hi/technology/3021873.stm accessed 8 Feb 05

Anonymous (2002), US Research Threat to Germ War Treaty

http://news.bbc.co.uk/1/hi/world/americas/2373271.stm accessed 8 Feb 05

Anonymous (2003), Rebuilding Iraq will cost $55 billion

http://news.bbc.co.uk/1/hi/business/3160800.stm accessed 23 Feb 05

Anonymous (2002), 'Timeline of Policy on Non-Lethal Weapons', Stars and Stripes Sunday Magazine, 22 December 2002

http://cndyorks.gn.apc.org/caab/articles/nonlethalweapons.htm accessed 24 Nov 04

Accessed from JDCC Internal NLW Database
Coppernoll, M and Maruyama, X K (1998), Legal and Ethical Guiding Principle and Constraints Concerning Non-Lethal Weapons Technology and Employment

Kim, P (2003), Between Principles and Absolutes: Non-Lethal Weapons and the Law of Armed Conflict

Loye, D A (2003), Non-Lethal Capabilities and International Humanitarian Law

Interview
Wing Commander M L Roberts, Equipment Capability-Deep Target Attack, Staff Officer 1, Future Combat Aerial Capability (EC-DTA SO1 FCAC), Ministry of Defence, 14 Dec 04

Unpublished Papers
Norton, C R, Wg Cdr (2004) Draft version of 'The Future Air and Space Operational Concept' dated 1 Nov 04 (this document has not yet been accepted by MOD and was still in the 1-Star level of the drafting process when presented to ACSC8 for information purposes in Nov 2004)

Hay, N J (2004), 'How successful were the Iraqis in countering Coalition air power and its effects in the first Gulf War (DESERT STORM) and what emerges from this case study that is of enduring relevance?'

ACSC8 Strategy and Policy Essay, 10 Dec 2004

Previous DRPs
Clarkson, M A (1999), Is There a Place for Non-Lethal Weapons in the MoDern Military Arsenal?

Cochrane, A (2004), Is There a Requirement for Non-Lethal Weapons: Are They Ethical and Legal?

Portlock, J B (2003), Non-Lethal Weapons: the Military Panacea or an Expensive Pipedeream?

Wallace, V J (2000), Non-Lethal Weapons: R2IPE for Arms Control Measures?

Wills, M (2001), Ongoing Urbanisation Will Increase the Likelihood of Military Operations Taking Place in Built Up Areas. How Might the Use of Non-Lethal Weapons Assuage the Public's Perceived Fears Concerning Casualties and Collateral Damage?

Treaties & Conventions
(All accessed via www.icrc.org/ihl.nsf)
Convention on the prohibition of the development, production, stockpiling and use of chemical weapons and on their destruction, Paris 13 January 1993:

http://www.icrc.org/ihl.nsf/52d68d14de6160e0c12563da005fdb1b/

Notes

[1] Moran (1966), p. 636

[2] Pease (2003), p. 131
[3] Gray (2001), p. 234
[4] Quinlan (1997), p. 1
[5] Clarke (2004), pp. 50-51
[6] Henderson (1995), p. 44
[7] Clarke (2004), p. 52
[8] Lindley-French (2004), p. 1
[9] Buzan (1991), p. 18
[10] Quinlan in Beach & Gurr (1999), pp. 245-250
[11] Sloss (2001), p. 437

[12] Gray (2000), p. 12
[13] Gray (2001), p. 236
[14] Gray (2000), pp. 12-14
[15] Beach & Gurr (1999), p. 246
[16] O'Neill (2000), pp. 195-198
[17] Beach & Gurr (1999), p. 246
[18] Donnelly (1999), pp. 82-83
[19] Ibid, p. 85
[20] Id.
[21] Beach & Gurr (1999), p. 246
[22] Rifkind (1993), p. 18
[23] Whitmore (1998), p. 1
[24] Rifkind (1993), p. 18
[25] Quinlan (2000), p. 46
[26] Id.
[27] Beach & Gurr (1999), p. 247
[28] Barrett (2002), p. 3
[29] Beach & Gurr (1999), p. 247
[30] http://news.bbc.co.uk/1/hi/world/south_asia/353150.stm accessed 3 January 2005
[31] Mueller (1998), p. 81
[32] Luttwak (1996), pp. 33-39
[33] Fukuyama (1989), p. 1
[34] Doyle (1994), p. 106
[35] Karsh (1994), p. 66
[36] Doyle (1994), p. 107
[37] Quester (2000), pp. 35-36
[38] http://www.globalsecurity.org/wmd/library/news/usa/1997/ap_970712.htm accessed 4 January 2005
[39] Beach & Gurr (1999), p. 249
[40] Quester (2000), p. 36
[41] Quinlan (1993), p. 496
[42] Beach & Gurr (1999), p. 250
[43] International Court of Justice, Advisory Opinion of 8 July 1996
[44] Id.
[45] Hoffman (2002), p. 313
[46] Barnaby (2003), p. 123
[47] Bolton in Butler & Bromley. (2001), Chapter 8.1
[48] Payne (2004), p. 1
[49] O'Neill (2000), p. 192
[50] Beach & Gurr (1999), p. 258
[51] Butler (2004), p. 1
[52] Gray (2001), p. 231
[53] Gowing (1974), p. 209
[54] Pierre in Baylis (1995), p. 2
[55] Clarke & Wheeler in Baylis (1995), p. 2
[56] Pierre (1972), p. 305
[57] Id.
[58] Gowing (1974), p.215
[59] Paul (1998), p. 33
[60] Pierre (1972), p. 91
[61] Garrity (1991), p. 477
[62] O'Neill (2000), p. 204
[63] Bundy (1988), p. 499
[64] Garrity (1991), p. 476
[65] Paul (1998), p. 34
[66] Krasno (2004), p. 5
[67] Pierre (1972), p. 304
[68] Clarke & Wheeler (1989), p. 232
[69] Pierre (1972), p. 304
[70] Heuser (1998), p. 38
[71] The Strategic Defence Review (1998), Chapter 3
[72] Crossman (1961), p. 334
[73] Pierre (1972), p. 308
[74] Pierre (1972), p. 319
[75] Pierre (1972), p. 311
[76] Garrity (1991), p. 498
[77] Paterson (1997), p. 176
[78] Nye (1992), p. 33
[79] Paul (1998), p. 39
[80] Bailey (1999), p. 100
[81] Davis (2002), p. 1
[82] Johnson & Scholes (1998), p. 25
[83] Robertson (1998), p. 38
[84] Johnson & Scholes (1998), p. 25
[85] Robertson (1998), p. 45
[86] Rühle & Rühle (2001), p. 221
[87] Kennett (1982), p. 71
[88] Biddle (1995), p. 127
[89] Rühle & Rühle (2001), p. 224
[90] Gray (2000), p. 20
[91] Id.
[92] Id.
[93] Rühle & Rühle (2001), p. 225
[94] Handel (1996), p. 95
[95] Joseph & Reichart (1996), p. 60
[96] Sengupta (1998), p. 31
[97] http://www.truthandpolitics.org/military-US-world.php accessed 12 February 2005
[98] Ben-David (2004), p. 5
[99] Sengupta (1998), p. 31
[100] Spring (2003), p. 1
[101] http://www.winstonchurchill.org/i4a/pages/index.cfm?pageid=388#world accessed 14 February 2005