



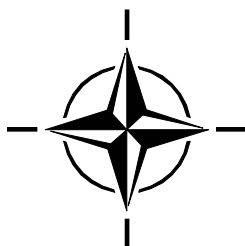
RTO TECHNICAL REPORT

TR-SAS-040

Non-Lethal Weapons and Future Peace Enforcement Operations

(Les armes non létales dans les opérations
d'imposition de la paix)

Report prepared by the RTO Studies,
Analysis and Simulation Panel (SAS).



Published November 2004





RTO TECHNICAL REPORT

TR-SAS-040

Non-Lethal Weapons and Future Peace Enforcement Operations

(Les armes non létales dans les opérations
d'imposition de la paix)

Report prepared by the RTO Studies,
Analysis and Simulation Panel (SAS).

The Research and Technology Organisation (RTO) of NATO

RTO is the single focus in NATO for Defence Research and Technology activities. Its mission is to conduct and promote co-operative research and information exchange. The objective is to support the development and effective use of national defence research and technology and to meet the military needs of the Alliance, to maintain a technological lead, and to provide advice to NATO and national decision makers. The RTO performs its mission with the support of an extensive network of national experts. It also ensures effective co-ordination with other NATO bodies involved in R&T activities.

RTO reports both to the Military Committee of NATO and to the Conference of National Armament Directors. It comprises a Research and Technology Board (RTB) as the highest level of national representation and the Research and Technology Agency (RTA), a dedicated staff with its headquarters in Neuilly, near Paris, France. In order to facilitate contacts with the military users and other NATO activities, a small part of the RTA staff is located in NATO Headquarters in Brussels. The Brussels staff also co-ordinates RTO's co-operation with nations in Middle and Eastern Europe, to which RTO attaches particular importance especially as working together in the field of research is one of the more promising areas of co-operation.

The total spectrum of R&T activities is covered by the following 7 bodies:

- AVT Applied Vehicle Technology Panel
- HFM Human Factors and Medicine Panel
- IST Information Systems Technology Panel
- NMSG NATO Modelling and Simulation Group
- SAS Studies, Analysis and Simulation Panel
- SCI Systems Concepts and Integration Panel
- SET Sensors and Electronics Technology Panel

These bodies are made up of national representatives as well as generally recognised 'world class' scientists. They also provide a communication link to military users and other NATO bodies. RTO's scientific and technological work is carried out by Technical Teams, created for specific activities and with a specific duration. Such Technical Teams can organise workshops, symposia, field trials, lecture series and training courses. An important function of these Technical Teams is to ensure the continuity of the expert networks.

RTO builds upon earlier co-operation in defence research and technology as set-up under the Advisory Group for Aerospace Research and Development (AGARD) and the Defence Research Group (DRG). AGARD and the DRG share common roots in that they were both established at the initiative of Dr Theodore von Kármán, a leading aerospace scientist, who early on recognised the importance of scientific support for the Allied Armed Forces. RTO is capitalising on these common roots in order to provide the Alliance and the NATO nations with a strong scientific and technological basis that will guarantee a solid base for the future.

The content of this publication has been reproduced directly from material supplied by RTO or the authors.

Published November 2004

Copyright © RTO/NATO 2004
All Rights Reserved

ISBN 92-837-1122-X

Single copies of this publication or of a part of it may be made for individual use only. The approval of the RTA Information Management Systems Branch is required for more than one copy to be made or an extract included in another publication. Requests to do so should be sent to the address on the back cover.

Non-Lethal Weapons and Future Peace Enforcement Operations

(RTO-TR-SAS-040)

Executive Summary

BACKGROUND

In 1999, an official NATO policy was approved and the CNAD entrusted RTO with forming one LTSS SAS-040 to identify NLW technologies to be further investigated in the period 2000-2020 in order to ensure that NATO could be successful through the whole spectrum of peace support operations. Within SAS-040, a Multinational Exercise (MNE) on NLW was organised in order to provide military planners with recommendations on the long-term planning for the use of NLW in peace support operations.

ORGANISATION OF THE LTSS/MNE

An MNE was organised with experts from DE, FR, GE, HU, NL, UK, US, SWE, HFM-073, NAAG/LG.3, SAS-035, SAS-041, SAS-049, IMS, IS, ICRC. The SAS-040 MNE was concluded on November 26th 2003. Six scenarios were developed covering a fairly broad spectrum of likely future NATO operations. A broad spectrum of possible future non-lethal weapon technologies, to be expected in the 2020 timeframe, was described. Both anti-materiel/-infrastructure, and anti-personnel technologies have been considered. The legal implications and constraints associated with the use of were analysed. It appeared that the Law of Armed Conflict (LoAC) is applicable to NLW. In addition to the legal aspects described above, the political implications and constraints related to the use of NLW have also been considered.

CONCLUSIONS

Using the scenarios and a structured approach for organising subject matter expertise (both operational and technological), SAS-040 identified five technologies/capabilities that best matched the requirements in the 2020 timeframe.

As for any other weapon, States have an obligation to determine the legality of new non-lethal weapons. In accordance with current NATO policy, NLW will continue to be complementary to (and will not replace) lethal weapons. There is no legal obligation to resort to non-lethal force when lethal force is authorised.

RECOMMENDATIONS

- Invest in R&D programmes on Radio Frequency and Stun Devices in order to satisfy key 2020 military requirements.
- To fully satisfy 2020 requirements with Anti-traction, Rapid Barriers & Nets, more rapid research progress and additional research investments would be needed.
- To determine whether current LoAC adequately addresses the use of NLW.
- In order to comply with their obligation to determine the legality of new weapons, states should aim to collect sufficient and reliable information about the effects of NLW.
- In order to ensure that NATO forces retain the ability to accomplish missions, NATO nations must remain vigilant against the development of specific legal regimes which unnecessarily limit the ability to use NLW.

Les armes non létales dans les opérations d'imposition de la paix (RTO-TR-SAS-040)

Synthèse

INTRODUCTION

En 1999, suite à une décision prise par le Conseil de l'OTAN, la CDNA a confié à la RTO la tâche de créer le LTSS SAS-040 afin d'identifier des technologies NLW susceptibles d'être étudiées plus avant pendant la période 2000-2020 pour assurer le bon déroulement de l'ensemble des opérations de soutien de la paix. Dans le cadre des activités du SAS-040, un exercice multinational (MNE) a été organisé, dans le but de fournir aux planificateurs militaires des recommandations concernant la planification à long terme de la mise en œuvre des NLW dans les opérations de soutien de la paix.

L'ORGANISATION DU LTSS/MNE

Un MNE a été organisé, avec la participation de divers spécialistes : DE, FR, GE, HU, NL, UK, US, SWE, HFM-073, NAAG/LG3, SAS-035, SAS-041, SAS-049, IMS, IS et ICRC. Le MNE SAS-040 a été conclu le 26 novembre 2003. Six scénarios ont été élaborés, couvrant un assez large éventail d'opérations OTAN possibles. Un grand choix de technologies NLW futures, susceptibles d'être mises en œuvre d'ici 2020, a été décrit. Les technologies antipersonnel, antimatériel et anti-infrastructure ont été examinées. Les conséquences juridiques ont été analysées, ainsi que les contraintes associées. Il a été confirmé que le droit des conflits armés (LoAC) était applicable aux NLW. En plus des aspects juridiques évoqués ici, les conséquences et les contraintes associées à la mise en œuvre des NLW ont également été prises en considération.

CONCLUSIONS

A partir des scénarios et d'une approche structurée de l'organisation des connaissances spécialisées pertinentes à disposition (tant opérationnelles que technologiques), le SAS-040 a recensé cinq technologies/capacités qui répondaient le mieux aux besoins prévus d'ici 2020.

En ce qui concerne tout autre type d'arme, les Etats sont dans l'obligation de déterminer la légalité de nouvelles armes non létales. Conformément à la politique actuelle de l'OTAN en la matière, les NLW seront toujours considérées comme complémentaires des armes létales, et elles ne les remplaceront pas. Il n'existe aucune obligation juridique d'avoir recours à des armes non létales dans des situations où l'emploi d'armes létales est autorisé.

RECOMMANDATIONS

- Les pays membres de l'OTAN devraient financer des programmes de R&D concernant le matériel radiofréquence et les armes paralysantes afin de pouvoir satisfaire aux besoins militaires clés à l'horizon 2020.
- Les besoins d'ici 2020 en antitraction, en barrières à montage rapide et en filets ne sauraient être satisfaits sans des progrès plus rapides en matière de recherche et des budgets plus importants.
- Les pays membres devraient également décider si la loi LoAC actuelle couvre de façon adéquate la mise en œuvre des NLW.
- Afin de se conformer à leurs obligations consistant à déterminer la légalité de nouvelles armes, les Etats devraient s'appliquer à la collecte de données fiables et en nombre suffisant concernant les effets des NLW.
- Afin de s'assurer de la capacité des forces de l'OTAN à exécuter leurs missions, les pays membres de l'OTAN devraient rester vigilants face à la prolifération de régimes légaux qui restreignent inutilement la capacité d'employer des NLW.

Table of Contents

	Page
Executive Summary	iii
Synthèse	iv
Preamble	vii
Chapter 1 – Introduction	1-1
1.1 Background	1-1
1.1.1 Context	1-1
1.1.2 NATO Policy	1-1
1.2 Origin of the Study	1-2
1.3 Aim of the MNE	1-2
Chapter 2 – Operational Scenarios	2-1
2.1 General Situation in 2020	2-1
2.1.1 Peace Support Operations	2-2
2.1.2 Application of International Resolutions	2-2
2.1.3 Asymmetric Threats	2-2
2.1.4 Urban Type Environment	2-3
2.2 Description of the Scenarios	2-4
Chapter 3 – Technologies of Interest	3-1
3.1 Introduction	3-1
3.2 Non-Lethal Anti-Material/-Infrastructure Technologies	3-2
3.2.1 Electromagnetic Technologies	3-2
3.2.2 Chemical and Biological Technologies	3-5
3.2.3 Mechanical Technology	3-7
3.3 Non-Lethal Anti-Personnel Technologies	3-8
3.3.1 Electromagnetic Technologies	3-8
3.3.2 Chemical Technologies	3-10
3.3.3 Acoustic Technologies	3-11
3.3.4 Mechanical Technology	3-11
3.3.5 Kinetic Technology	3-12
3.3.6 Combined Technologies	3-14
Chapter 4 – Legal and Political Aspects	4-1
4.1 Legal Aspects	4-1
4.1.1 Law of Armed Conflicts (LoAC)	4-1
4.1.2 Terms of the Mandate Given to the Force and Rules of Engagement (ROE)	4-6
4.1.3 Labour Law	4-6

4.2	Political Considerations	4-7
4.2.1	Political Aspects	4-7
4.2.2	Armed Forces	4-7
4.2.3	Non-State Actors	4-8
4.2.4	Public Opinion in the Nations Taking Action	4-8
4.2.5	Non-Governmental Organisations	4-9
4.2.6	The Media	4-9
4.3	Considerations Relating to Scenarios	4-10

Chapter 5 – Conclusions and Recommendations of the Multinational Exercise **5-1**

5.1	Conclusions	5-1
5.1.1	Operational and Technological Conclusions	5-1
5.1.2	Legal and Political Conclusions	5-2
5.2	Recommendations	5-3
5.2.1	Operational and Technological Recommendations	5-3
5.2.2	Legal and Political Recommendations	5-4

Annex A – List of Abbreviations **A-1**

Annex B – NATO Policy on Non-Lethal Weapons **B-1**

Annex C – Guidelines for Legal Review of NLWs **C-1**

Annex D – List of Participants **D-1**

Annex E – Scenario Analysis and Description **E-1**

(This Annex is NATO UNCLASSIFIED RELEASABLE TO SWEDEN and shall only be distributed upon request to RTA/TSCO)

Annex F – Table on NLW Anti-Equipment/-Infrastructure Weapons **F-1**

(This Annex is NATO UNCLASSIFIED RELEASABLE TO SWEDEN and shall only be distributed upon request to RTA/TSCO)

Annex G – Table on Non-Lethal Anti-Personnel Weapons **G-1**

(This Annex is NATO UNCLASSIFIED RELEASABLE TO SWEDEN and shall only be distributed upon request to RTA/TSCO)

Preamble

This document is the final report of the NATO Multinational Exercise (MNE) that took place in Bourges (France) from the 17th to the 21st of November 2003. This MNE was organised under the aegis of the Long Term Scientific Study (LTSS) SAS-040 on Non-Lethal Weapons and Future Peace Enforcement Operations.

An expert of the International Committee of the Red Cross (ICRC) participated in the MNE. However, as a representative of an independent and impartial humanitarian organisation, this expert was not in a position to adhere to the conclusions or recommendations on NLW technologies adopted during the exercise.



Chapter 1 – INTRODUCTION

1.1 BACKGROUND

1.1.1 Context

The last decade has been marked by fundamental developments and changes in the world around us. Two of the main factors have been the disappearance of the system of opposing East and West blocs on the one hand, and the mastery of an ever-increasing range of new technologies on the other.

Where the armed forces are concerned, these upheavals have been accompanied by the appearance of new missions of interposition or peace support, increasingly in urban terrain. The media spotlight on these conflicts and the impact of public opinion on their conduct also mean that military circles prefer to use the least violent possible means which minimise collateral damage.

Civil authorities are likewise facing serious changes in the situations they have to deal with. As well as managing public unrest and demonstrations, today they also have to cope with new missions, such as responding to terrorist attacks or hostage-taking and combating drug traffickers etc.

All these factors together are generating the need for a wider choice of means of action to be available, allowing a more graduated deployment of force:

- Possibility of intervening even when the use of conventional weapons is not conceivable;
- Ability to seize or keep the initiative while minimising collateral damage.

Thus, the concept of non-lethality offers possible responses to the new environment of civil and military action.

1.1.2 NATO Policy

In April 1994 the Conference of National Armaments Directors (CNAD) entrusted the precursor to the NATO Research and Technology Organisation (RTO) with forming a Specialist Team to work on non-lethal weapons. This Team considered the feasibility and usefulness of non-lethal weapons in peacekeeping and peace enforcement operations, and identified possibilities for international co-operation in research and development of the most promising NLW technologies. The Specialist Team issued a report, AC/259-D/1667 dated 19 March 1996, entitled “Non-lethal weapon technologies for peace support operations”.

In 1997 the Council identified the need for a common NATO policy on NLW. A Non-Lethal Weapons Policy Team was set up. The team provided a draft NATO policy on the subject. This draft was approved and accepted in 1999 as the official NATO policy on NLW (Final Report of the NATO NLW Policy Team, C-M(99)44, 28 September 1999).

The NATO policy on NLWs defines NLW as follows:

“Non-lethal weapons are weapons which are explicitly designed and developed to:

- *incapacitate or repel personnel, with a low probability of fatality or permanent injury;*
- *disable equipment, with minimal undesired damage or impact on the environment.”*

INTRODUCTION

According to this definition, it appears that NLWs:

- Do not always prevent fatalities or injuries;
- May be used in conjunction with lethal weapon systems.

The whole text of the NATO policy on non-lethal weapons is given in Annex B or NATO Press Statement 13 October 1999. To supplement the above definition, it is considered that information warfare assets are excluded from the category of NLW.

1.2 ORIGIN OF THE STUDY

NLW provide civil and military forces with new capabilities of adaptation, graduated response and flexibility of use of resources.

However, the appearance of these new capabilities raises a number of scientific, legal, ethical and political questions to be considered as part of the process of identifying new potential non-lethal weapon technologies deserving development for the future.

In this context, the CNAD entrusted the RTO with forming an Exploratory Team with the aim of:

- Drafting a planning schedule for the development and introduction of NLW for operational applications;
- Preparing a draft TOR and Work Programme for a Group (SAS-035) responsible for improving NATO's capability of assessing the effectiveness of NLW systems for the whole operational spectrum of warfare and crisis response;
- Preparing a draft TOR for a Long-Term Scientific Study (LTSS) on NLW.

As a consequence of this latter item, SAS-040 on NLW was created with the aim of identifying non-lethal technologies to be further investigated in the period 2000-2020 in order to ensure that NATO could be successful through the whole spectrum of a peace support operations.

Within SAS-040, a multinational exercise (MNE) on NLW was organised in order to provide military planners with recommendations on the long-term planning for the use of NLW in peace support operations.

1.3 AIM OF THE MNE

The NATO multinational exercise (MNE) on NLW took place in Bourges (France) from the 17th to the 21st of November 2003.

The final objective of this MNE was to answer the question: **“How will operational staff carry out full spectrum of peace enforcement operations in the 2020 timeframe using NLW, and which non-lethal technologies are the most appropriate and credible for such operations?”**

To achieve this aim, experts from various origins – military, lawyers, technical experts, representatives of industry, etc. – were invited to take part in this MNE so as to take into account the requirements, constraints and concerns arising in their respective fields.

An expert of the International Committee of the Red Cross (ICRC) also participated in the MNE. However, as a representative of an independent and impartial humanitarian organisation, this expert was

not in a position to adhere to the conclusions or recommendations on NLW technologies adopted during the exercise.

The LTSS SAS 040 has adopted three main themes in tackling the use of NLW:

- Operational context
- Technologies which can be envisaged
- Legal and political implications and constraints

This document is the final report of the MNE. The three main themes mentioned above are addressed in Chapters 2, 3 and 4 respectively.

The conclusions and recommendations produced during the MNE are presented in Chapter 5.



Chapter 2 – OPERATIONAL SCENARIOS

The purpose of developing scenarios was to provide multiple operational contexts within which the application of future capabilities could be examined. These scenarios were meant to facilitate analysis of how best to accomplish assigned mission tasks and satisfy target and collateral constraints. This work supported an assessment of which basic capabilities would be of highest likelihood, impact, and NLW relevance in the 2020 timeframe and which technologies would best match the requirements associated with these key basic capabilities.

The six scenarios developed by SAS-040 were:

- Scenario 1: *Rescue operations at a critical site in urban terrain*
- Scenario 2: *Threat of Weapons of Mass Destruction (WMD) in urban terrain*
- Scenario 3: *Protection of key installations*
- Scenario 4: *Crowd control at a food aid distribution point and checkpoint operation*
- Scenario 5: *Protection and evacuation of a minority population*
- Scenario 6: *Asymmetric threat*

This section of the report describes the general situation in 2020, an overview of scenario characteristics, the six scenarios developed and analysed by SAS-040, and conclusions and recommendations resulting from scenario analysis.

2.1 GENERAL SITUATION IN 2020

Sketch of the world in 2020:

- NATO is still active with peace support operations as its major task.
- NLWs are part of the inventory of most member nations.
- Global population has increased as has the number and size of cities, making urban terrain a key operating environment with activities taking place in very complex terrain (to include inside and underground).
- National laws of NATO member states are more synchronised.
- The distinction between military operations and law enforcement is becoming less clear. The activities and capabilities of organised criminal groups may be similar to those of terrorist groups.
- Acceptance of collateral damage is less than today, and expectations for achieving a desired outcome are even higher.
- Tremendous amounts of information are available and accessible. Not only do the traditional media broadcast in real-time with instantaneous impact but also a great number of individuals possess the ability to record and transmit (and receive) information anywhere at any time.
- Global society is more interconnected than today, making the gap between the interconnected “haves” and the more isolated “have-nots” wider. Even the isolated “have-nots,” however, are able to communicate on a global scale, allowing for greater co-ordination among the disaffected.
- Due to external threats, individual and civil liberties have been degraded.

OPERATIONAL SCENARIOS

- Ethnic and political groups are more aware of their identity.
- More terrorist and criminal organisations operate on a global scale.

Consistent with the terms of reference of SAS-040, this long-term scientific study analysed requirements and capabilities across multiple operational contexts, focusing on:

- Peace support operations,
- Application of international resolutions,
- Asymmetric threats,
- Urban environments.

The following paragraphs elaborate on the operational contexts and key factors considered during scenario development and analysis.

2.1.1 Peace Support Operations

As noted, NATO is forecast to remain active in peace support operations in the 2020 timeframe, and peace support operations are understood to cover all situations identified in figure 2.1:

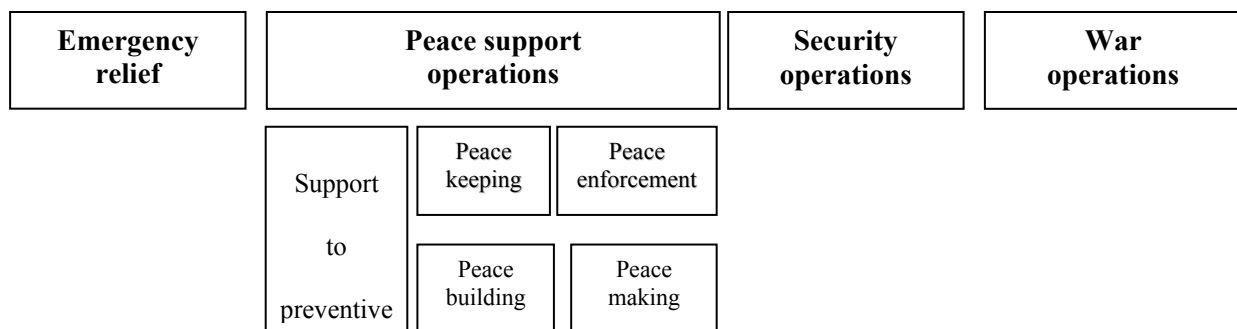


Figure 2.1: Spectrum of Military Operations.

The focus of SAS-040's work was on peace support operations, but scenarios of higher and lower intensity were also developed and analysed to ensure that military requirements and NLW capabilities were addressed within a broad context.

2.1.2 Application of International Resolutions

All six scenarios were assumed to take place in the context of applying resolutions of the UN or regional organisations acting with the approval of the UN.

In each case, NATO is responsible for the assigned mission, but non-NATO nations are also participating.

2.1.3 Asymmetric Threats

In the 2020 timeframe, NATO will continue to possess military capabilities that make it difficult or impossible for an adversary to achieve its objectives through symmetric confrontation (i.e. employing conventional capabilities in direct force-on-force engagements while complying with the laws of armed conflict). Asymmetric threats may arise from:

- Inter-ethnic violence,
- Terrorist activity,

- Organised criminal activity,
- WMD threats or other forms of non-conventional warfare.

The following table illustrates areas in which adversaries may attempt to confront NATO in an asymmetric fashion:

Table 2.1: Potential Sources of Asymmetry

Asymmetry in	NATO	Adversary
Objectives	Restore/Maintain Stability	Create/Exploit Instability
Forces	Uniformed	Irregular
Weapons	Legal Weapons (All weapons – conventional and NLW – will comply with international treaties and conventions and with national laws.)	Unconventional Weapons (These may include prohibited weapons, improvised devices, the use of civilian facilities and equipment as weapons, or the use of legitimate weapons in an unlawful way.)
Targets	Legitimate Targets (All targets will comply with the principles of the laws of armed conflict: military necessity, discrimination, proportionality, and minimisation of unnecessary suffering.)	Legitimate and Illegitimate Targets Civilian and protected targets (both inside the conflict area and elsewhere) may be attacked if such actions serve an adversary’s objectives.
Tactics	Capitalise on Capabilities Use numbers, mobility, weapons/systems effects, etc. to bring the right capabilities to bear to achieve desired outcomes.	Capitalise on Patience Use the ability to choose times, places, and targets (and willingness to use irregular forces and unconventional weapons) to advantage.

2.1.4 Urban Type Environment

In 1999, in its technical report on land operations in 2020¹, the RTO concluded that it was highly probable that in future NATO forces would have to conduct operations in the urban environment. This conclusion was reinforced in the work of SAS-030², which specifically addressed urban operations and implications for NATO.

Urban environments pose specific challenges as a result of the complex terrain (density of infrastructure, operations inside buildings or underground, etc.), the proximity of non-combatants, and the potential for undesirable collateral damage. In order to address these complications and particular constraints, four of the scenarios – numbers 1, 2, 5 and 6 – have urban complexity.

¹ Reference citation for Land Operations 2020.

² Reference citation for SAS-030, Urban Operations.

2.2 DESCRIPTION OF THE SCENARIOS

In this sub-section, the report describes the major elements addressed during scenario development as well as an overview of each of the six scenarios (detailed results from scenario analysis are included in Annex E).

Major scenario elements include:

- **General description**
 - Overarching operational context for the scenario,
 - Nature of the threat.
- **Tactical objectives and constraints**
 - Detailed description of objectives.
 - Operational, legal and political factors that limit the set of available options, i.e., that constrain actions that can be taken while seeking to accomplish assigned tasks.
 - Target constraints affect what actions (or weapons) that can be used against a target (e.g., not destroying a key piece of infrastructure – such as a bridge or tunnel – while denying access in order to preserve it for later use).
 - Collateral constraints affect actions based on what is in the vicinity of a target (e.g., the proximity of non-combatants or own forces).
- **Basic capabilities**
 - Basic capabilities necessitating potential NLW use are as follows:
 - 1) Crowd control/channelling.
 - 2) Separating groups of individuals.
 - 3) Rescuing of individuals/groups.
 - 4) Removing individuals from a crowd.
 - 5) Marking individuals and groups in a crowd.
 - 6) Dispersion of a crowd.
 - 7) Denying persons from accessing an area.
 - 8) Denying ground, air and sea vehicles from accessing an area.
 - 9) Protection of individuals/groups.
 - 10) Neutralisation of individuals and groups.
 - 11) Neutralisation of ground, air, airspace, sea, underwater vehicles.
 - 12) Neutralisation of infrastructure and facilities.
 - 13) Protection of facilities and equipment.
 - 14) Neutralisation of weapons and military equipment.
 - 15) Clearing a facility.
 - 16) Neutralising communications (this was a supporting capability added to the list because it was desired in nearly all scenarios).

Specific Targets Parameters

1) Target Range:

Distance separating the target from the place where the NLW is used;

- Three zones have been defined relative to the location of the target, here taken as the point of reference:
 - Zone 1: inside the buildings concerned or at a short distance (< 100 m).
 - Zone 2: at moderate range (about 100 – 1000 m).
 - Zone 3: at a long distance (about 1 km or more).

2) Time of onset of action:

- Maximum time between triggering the NLW and the occurrence of its desired effect.
- Three orders of magnitude are distinguished:
 - Second.
 - Minute.
 - Hour.

3) Duration of action:

- Duration of the effect of a ‘single shot’ of a non-lethal weapon.
- Five measures are distinguished:
 - Second.
 - Minute.
 - Hour.
 - Days.
 - Controlled.

4) Basis Responses/Effects on Targets:

- Parameters which may be affected in order to carry out the associated basic action;
- Seven basis responses have been adopted:
 - Mobility/movement capability.
 - Communication.
 - Physical function of the target.
 - Senses (disorientation of ability to sense and interpret).
 - Cohesion (of the target group).
 - Motivation.
 - Identification.

Further, the following parameters have been considered during technology assessment.

OPERATIONAL SCENARIOS

5) Area of Effect:

The area of effect (sometimes referred to as effective range), has been defined as the area in which (or the range until which) the effect works. Two radii of zones, or distances are distinguished:

- < 100 m
- 100 m – 1000 m
- > 1km

6) Maturity:

Maturity has been defined for two different timeframes, current and the year 2020.

Three situations are distinguished:

- Under R&D,
- Prototype available,
- In production.

Scenario 1: Rescue Operations at a Critical Site in Urban Terrain

A group of freedom fighters has taken hostages to coerce the government to release an imprisoned rebel leader. The rebels made sure there is heavy media coverage of the event. However, the government learned that the rebels intend to capture a chemical plant and eventually release a toxic cloud if conditions are not met. The chemical plant is located on a riverbank, in the immediate vicinity of a city. Closing the plant down is not an option. At this point, the rebels are moving towards the plant in a small boat with the hostages onboard.

The objectives associated with this scenario are preventing the rebels from reaching the chemical plant and releasing a toxic cloud as well as rescuing the hostages. Meeting the first objective will involve denying an area to vessels, denying an area to personnel, and potentially neutralising or clearing facilities. Meeting the second objective will involve neutralisation of individuals or groups and rescuing of individuals or groups. Key constraints include avoiding a toxic release, minimising damage to facilities and infrastructure, and minimising harm to hostages (also, it is desired not to kill the rebels but instead to allow the government to bring them to justice).

Scenario 2: Threat of WMD in Urban Terrain

The military is involved in liberating a country led by a dictator. As the military approaches the country's capital, within which a large number of civilians have been forced to serve as human shields including in close proximity to WMD production and storage sites. The dictator is threatening to launch WMD (chemical and/or biological materials) attacks. In addition, there are terrorist cells operating in the capital, and they may represent another means for the dictator to apply the WMD threat. In addition to main forces approaching the capital, NATO has Special Forces already operating in the capital.

In this scenario, the key objectives are to secure WMD materials, protect civilians from threats posed by the dictator and his regime, and to address the threat posed by terrorists. The first objective will involve preventing movements by land, sea, and air; capturing and controlling facilities; and seizing or sealing/neutralising WMD materials. The second objective will involve facilitating the release of human shields; capturing or neutralising, guards; and denying or degrading the regime's ability to move, sense, or communicate. The final objective will include identifying, marking, tracking, and seizing/neutralising terrorists. Associated with the objectives are a couple of overarching constraints: avoiding the release or dissemination of WMD materials and minimising civilian casualties.

Scenario 3: Protection of Key Installations

A large city holds a substantial amount of military and government facilities and infrastructure, including land, sea and air assets. The government received a threat report that an attack on an unspecified part of these facilities / infrastructure is imminent. The nature of this potential attack is unknown. The available sensor network monitors the environment and detected a hostile group moving about. The intent of the group is not clear. The military has a rapid reaction force available and may launch a preventive action, sanctioned by the responsible authority.

The key objectives for this scenario are to control crowds and to protect facilities, equipment, and individuals. The associated constraints are to minimise harm to non-combatants and to the civil infrastructure.

Scenario 4: Crowd Control at a Food Aid Distribution Point and Checkpoint Operations

Conflict has ended in an urban area, and now the mission is to secure an area allowing food/water distribution to take place. There is a big UN HCR warehouse. There is a very large, desperate crowd. The threat of starvation is there. Intelligence says - hostile action expected by OPFOR / criminals in the crowd.

The objectives are to take all necessary actions to ensure that food and water can be distributed within a secure environment. Supporting tasks involve protecting the warehouse, protecting re-supply convoys, checkpoint establishment, crowd control/channelling, and prevent hostile acts.

Scenario 5: Protection and Evacuation of a Minority

A minority group in a village asks to be protected from the majority group. Preventive action is taken to protect the minority group, but the initial protection effort fails. The minority group demands to be evacuated out of the village. During the evacuation, a hostile crowd attempts to prevent the evacuation.

The key objective is associated with movement and action through a crowd. Supporting tasks include area denial, securing lines of communications, carrying out an evacuation, crowd control, and neutralisation of individuals and groups demonstrating hostile intent.

Scenario 6: Asymmetric Threat

At the invitation of a government faced with narco-terrorist threats beyond their capacity to address, NATO deploys forces to help stabilise the situation, to prevent the spread of security problems and instability across borders to other countries in the area, and to target the narco-terrorists and prevent them from conducting attacks here or elsewhere.

The objective for this scenario is to identify, mark, track, and neutralise the narco-terrorists and to prevent or degrade their ability to access civilian facilities and equipment. Constraints include minimising civilian casualties, safeguarding major facilities and equipment for future use, and preserving the ability to prosecute narco-terrorists.

Annex 3 includes a series of tables that provide more details on each of the scenarios including the desired engagement range, onset time, duration, and recovery associated with specific tasks (and constraints).



Chapter 3 – TECHNOLOGIES OF INTEREST

The aim of this chapter is to present the non-lethal antipersonnel, anti-material/-infrastructure technologies and systems which might be used around 2020, taking account of technological aspects.

It must be noted that:

- A lethal weapon used in a non-lethal way, does not fall under the category of NLW;
- Purely psychological, information or electronic warfare operations are excluded from the category of NLW.

3.1 INTRODUCTION

The aim of this chapter is to describe a broad spectrum of possible future non-lethal weapon technologies to be expected in the 2020 timeframe.

Both anti-materiel/-infrastructure, and anti-personnel technologies have been considered.

The anti-material/-infrastructure technologies have been divided into three main categories (see Par. 3.2.):

1) Electromagnetic Technologies

- Radio frequency devices
- Lasers

2) Chemical and Biological Technologies

- Chemical
 - Slippery foam
 - Sticky foam
 - Super adhesive substances
 - Super caustics
 - Graphite powders
- Biological
 - Bacterial agents

3) Mechanical Technologies

- Rapid barriers
- Nets and entanglements
- Tire puncturing techniques

The anti-personnel technologies have been divided into six main categories (see Par. 3.3.):

1) Electromagnetic Technologies

- Microwaves
- Lasers

TECHNOLOGIES OF INTEREST

- Electromagnetic launchers
- Electromagnetic mines

2) Chemical Technologies

3) Acoustic Technologies

4) Mechanical Technologies

- Rapid barriers
- Nets & entanglements

5) Kinetic Technologies

- Blunt impact

6) Combined Technologies

- Kinetic/Acoustic
- Laser/Radiation
- Optical/Heat

For each technology the six specific target parameters (as described in Chapter 2.2.) have been defined. The results have been summarized in Annex F for anti-material/-infrastructure non-lethal weapon technologies, and in Annex G for anti-personnel non-lethal weapon technologies.

3.2 NON-LETHAL ANTI-MATERIAL/-INFRASTRUCTURE TECHNOLOGIES

3.2.1 Electromagnetic Technologies

3.2.1.1 Radio Frequency (RF) Devices

a) Principles and System Description

The threat from electromagnetic pulses (EMP) generated in connection with nuclear explosions has been well-known since the first tests of nuclear weapons in the atmosphere. Radio frequency (RF) weapons, based on frequencies in the 10 MHz to 100 GHz range, can cause similar effects using high-power generators connected to a suited antenna. They produce a burst of energy, which damages the components of electronic systems or disrupts their operation.

Radio frequencies can be envisaged to produce the electromagnetic equivalent of spike strips and to disrupt electronic equipment.

These systems may be recurrent in operation (the effect can be repeated) or single-shot. The energy required to operate these systems may be stored in electrical form (in batteries or produced in generators), in chemical form (as explosives) or in piezo electric devices. The systems may be fixed or portable (ground, sea, air), and delivered by (un)manned means.

The emitted wave can have various characteristics:

- Pulsed or continuous.
- Narrowband or broadband.

- Mean and peak power.
- Wave form.
- Pulse repetition rate (there may only be one pulse).
- Pulse duration and frequency.

Typical purposes of RF devices are the neutralization of enemy weapon systems, military equipment, infrastructure and facilities by destroying their electronic components without the use of lethal munitions.

The future RF weapon systems could be divided into different system sizes. Smaller systems may be delivered by projectiles, the effects being initiated by a separate power source like batteries, explosives or piezo elements. More effective systems can be installed inside bigger platforms like ground vehicles, glide bombs, UAV and other airborne systems. They can act repetitively, can cover a wide area, eventually over a long time.

High priority will be given to man portable RF systems for easy, covert and fast use to act against control, communication, surveillance, alarm and radio controlled systems off the shelves. This technology allows to act against crowd leaders by taking their ability to spread their information into the crowd (e.g. by radio or cell phone).

RF sources can be used in urban terrain to increase the protection against radio controlled bombs or to stop vehicles breaking through simple road barriers. The RF sources can be vehicle mounted or be integrated in easy and fast set up street barriers. Energy supplies can be simple generators or rechargeable battery systems.

The target range for RF devices will be the range of the used carrier platform. This goes from several hundred meters for ballistic projectiles up to several hundred kilometers for UAVs / cruise missiles.

The effective range of the RF effect is limited by the available volume and payload inside the platform (projectile, mortar munitions, portable device, vehicle, artillery rocket, UAV, etc.). The expectation for 2020 for a man portable device against unprotected COTS equipment is about 50 m to 500 m. For a vehicle mounted long range RF weapon against remote controlled flying objects, an effective range of 5 km to 25 km is expected. The affected area can vary from a few m² up to several thousand m² depending on the beam-pattern and the related range to the target of the RF device.

The delivery accuracy for the carrier platforms should be within the effective range of the RF payload.

In order to protect facilities and high value equipment, ground based long range RF sources will be capable of acting against flying threats in the range of small radio controlled planes up to intelligent missile systems.

The onset time for RF devices is typically below 1 second. The required radiation time depends on the desired effect on the target. For causing disruption without any long term destruction at the target, it may be necessary to radiate as long as the target has to be disrupted. For long lasting destruction of electronic components of the target, a short radiation time (less than 1 second) with high energy is sufficient. In the latter case usually the target system has to be repaired by replacement of damaged electronic components.

b) Advantages and Disadvantages

RF weapons can be used for covert operations, independent of weather conditions. By comparison with laser weapons (see following paragraph) the effectiveness of RF weapons is relatively independent of weather conditions and can propagate into buildings and shelters without being within line of sight.

TECHNOLOGIES OF INTEREST

When employed against targets, the weapon will be the more effective the more modern the technology of the target. Nevertheless, although these weapons are suitable for use against ground and naval vehicles, their effect may be lethal against air targets.

Their “dispersion” may also cause undesirable disruption to other equipment, which is not the target (communication networks, television systems etc). The actual impact in a given situation may be uncertain, unless the basic vulnerabilities of the target are known.

The long-term physiological effect of the waves received by an individual near or inside targets (such as vehicles), or by those operating the weapon (effect of side-lobes) are still under study, and could be an obstacle to the use of radio frequencies for non-lethal weapons. However, the field levels required to destroy/disrupt electronic equipment are usually already below the actual legal limit for human exposure to pulsed RF radiation. Additionally, this is only a single short-time irradiation.

The countermeasure for RF sources is to shield the targets against electromagnetic influences, whereas it is quite difficult to shield systems with communication capabilities. It requires long vulnerability investigations and complex shielding technologies. This will lead to very high development costs, so that Commercial Off The Shelf (COTS) will most probably not be shielded in the future.

3.2.1.2 Laser

a) Principles and System Description

Lasers are sources of coherent monochromatic light.

They can be used to “blind”, damage or destroy certain systems, including optical systems at which they are aimed (fire control systems, sighting systems, night vision goggles etc). The most powerful lasers, such as the American airborne advanced tactical laser (ATL) destroy their targets by heating.

The future high-power infrared laser weapon system can destroy different structures. The main purpose is the destruction of weapons (missiles), military equipment (UAV, ground robots, electrical distribution equipment,...). A destruction effect means localised fusion and/or vaporisation of the exposed part of the target. This laser weapon can be mounted on a vehicle (ground, air, sea). The time of onset of action is short (below 1 second by assuming that the beam is pre-pointed in the right direction). The duration of the effect can be controlled. The target range can reach 5 km.

Another kind of laser can be used for more limited actions on materials : the femtosecond laser can puncture for instance inflatable boats. In the future it should be man-portable and require less energy than the previous one.

Anti-materiel dazzling laser is another application in order to jam different optronic devices. This kind of laser requires less energy than high-power laser and femtosecond laser (For more details see. paragraph 3.3.1.2).

b) Advantages and Disadvantages

The advantages of using lasers for destruction or puncture is that the effect is very accurate with no collateral damage. Moreover, the temperature induced by the high-power infrared laser is very important and it can result the annihilation of a chemical or biological substance.

Compared with a classical gun, the advantage of the femtosecond laser and the dazzling laser are the possibility to graduate the energy and to be more discrete (no detonation).

These laser performances are dependent on weather or dust conditions. There are possible countermeasures depending on the future materials.

Adjusting the emissions correctly is very important, as excessive powers may cause serious damage, above all to the crew of the target platform.

3.2.2 Chemical and Biological Technologies

3.2.2.1 Chemical

a) Principles and System Description

Chemical agents may be used to immobilise vehicles. They act on the tyres, the optics and sensors (windscreen, video lenses, mirrors etc), the engine and the fuel.

For example, the following means of action may be mentioned:

- The tyres: glue, solvents, oxidants etc.
- The petrol: gelling agents, non-combustion additives.
- The optics: opacifiers.
- The engine: gelling agent for the lubricants and gasses prevent combustion of fuel in the engines.

Chemical agents may also destroy equipment and deny access to areas and buildings. Supercaustic substances/liquid metal embrittlement (LME) chemicals have the ability to dissolve metals, plastics, rubber, glass, etc.

The use of all chemical agents must be properly controlled to limit their effects on the environment, toxic action on people and indirect consequences of their use against vehicles moving at high speed for instance.

Before the use of those technologies, it's necessary to make sure that all the chemical constituents used in every agent are authorised by the international conventions.

Chemicals can be delivered by pressured containers, encapsulated droplets, or by direct contact (pouring, painting).

b) Advantages and Disadvantages

Must involve direct contact. They can have serious effects on personnel, transport or storage materials and the environment. Precaution must be exercised, as chemicals may be lethal to personnel. Countermeasures are unlikely even in the 2020 timeframe.

1) Slippery Foams

a) Principles and System Description

Their purpose is to prevent vehicles from moving by limiting contact with surface terrain. Agents decrease functional to near zero.

b) Advantages and Disadvantages

Preserve equipment and infrastructure. Their effectiveness depends on weather conditions.

TECHNOLOGIES OF INTEREST

2) *Sticky Foams*

a) *Principles and System Description*

Condensed polymer foams are intended to hinder the movement of vehicles or to immobilise them.

b) *Advantages and Disadvantages*

Preserve equipment and infrastructure.

Inhalation of or contact with these foams can have serious health consequences.

Cleaning may be difficult and lengthy, and the non-toxicity of the solvents is not proven at present.

3) *Super-Adhesive Substances*

a) *Principles and System Description*

Like foams, these substances are intended to hinder the movement of vehicles or to immobilise them completely.

b) *Advantages and Disadvantages*

Preserve equipment and infrastructure.

Inhalation of or (eye-) contact with these chemical agents can have serious health consequences.

Cleaning may be difficult and lengthy, and the non-toxicity of the solvents is not proven at present.

4) *Super-Caustic Substances/Liquid Metal Embrittlement (LME)*

a) *Principles and System Description*

These chemical agents have the ability to dissolve metals, plastics, rubber, glass etc.

b) *Advantages and Disadvantages*

They can have serious effects on people and the environment.

5) *Graphite Powders*

a) *Principles and System Description*

Carbon or graphite powders can be used to put electrical systems/installations out of action by creating short circuits.

b) *Advantages and Disadvantages*

Inhaling these powders can have serious consequences for people.

3.2.2.2 **Biological**

a) *Principles and System Description*

Microbial agents (enzymes, bacteria) may be used to immobilise vehicles, inactivate equipment with rubber or plastic parts, or destroying storages. The specific targets could be rubber, plastic and other petroleum products. The function of the targets would be compromised or destroyed.

The material is easily portable in small amounts and delivers a large effect over time. Covert action of effect on target is possible.

There are environmental restrictions on portability. Potential difficulties exist in limiting specificity to the enemy target. Biological and environmental hazard of mutation to alternate forms is possible.

It is difficult to identify the existence of bacteria as the NL-technology. Once identified stopping the process is possible.

3.2.3 Mechanical Technology

3.2.3.1 Rapid Barriers

a) Principles and System Description

A passive means of traffic management could be achieved by the deployment of appropriate rapid barrier technology.

Control may be achieved via fast rising portable, telescopic cylinders between which nets or similar constructions, airbags or plastic films, could be suspended. The system could be fixed to protect permanent assets.

b) Advantages and Disadvantages

The barrier system is seen as an excellent means of deterring the passage of light or soft skinned vehicles and would be an appropriate means of rapidly erecting a manned barricade. The effectiveness against a determined force equipped with tracked or heavy vehicles is considered to be limited. The system is transported in a light truck and could be deployed within minute of arrival at the required site.

3.2.3.2 Nets & Entanglement Techniques

a) Principles and System Description

The arresting of moving cars and trucks vehicles may be achieved by entanglement of the running gear. This may be achieved via the deployment of wires or fibres and there are several available systems in existence, which work in this way.

Micro wires are thin steel wires compacted under tension. When deployed the wires expand to assume pre-determined geometric shapes formed from a tangle of the wire itself. Expansion ratios of 1:6000 are achievable. When deployed the devices could be used to prevent access by vehicles to designated areas.

The X-net system works by using wires across the path of an oncoming vehicle to entangle the wheels and axles. The system is seen as an alternative to the use of Caltrops or the spike strip.

The Portable Vehicle Arresting Barrier (PVAB) device is designed to arrest a light truck or similar vehicle travelling at a speed of around 70 kph and bring it to a halt in about 30 to 40 metres. The net wraps around the vehicles holding the doors closed. Once in place normal traffic flow is permitted until it is activated. The device can be activated in less than 2 seconds. When the device is activated two masts are pneumatically raised stretching an elastic barrier between them.

b) Advantages and Disadvantages

The PVAB system is cumbersome to deploy (about 2 hours from arrival). The X-net represents a much more rapid and more easily deployed system. Entanglement systems also represent a significant advantage

TECHNOLOGIES OF INTEREST

in as much that the driver can maintain some form of control over the vehicle. This is not possible after rapid deflation of the tyres when using Caltrops or similar devices.

Micro wires represent a means of erecting an impenetrable barrier to deny access to an area or building. The technology could be extended to provide propeller entanglement to stop small boats and patrol craft if the system could be deployed just below the surface. A further extension of the technology could be to ensnare the rotor blades and tail rotors of helicopters on the ground.

3.2.3.3 Tyre Puncturing Techniques

a) Principles and System Description

The use of the hollow tube spike strip or “stinger” device is well known and is readily available for use for today’s forces. Caltrop devices are also well known and represent proven technology for stopping vehicles.

Caltrops are pyramidal spikes that are scattered onto the road in order to deflate the tyres of oncoming vehicles. The spike strip is an extension of this technology where the tyres are deflated by hollow tubes, which puncture the tyres and allow steady deflation.

b) Advantages and Disadvantages

Neither the Caltrops nor spike strips are effective against tracked vehicles. The control aspect has been discussed in an earlier paragraph.

3.3 NON-LETHAL ANTI-PERSONNEL TECHNOLOGIES

3.3.1 Electromagnetic Technologies

3.3.1.1 Microwaves

a) Principle

Microwaves could replace mines thanks to their anti-personnel action. They can produce a burning sensation, but without causing skin lesions if the frequencies and power ceilings are properly set ($P < 4 \text{ W/kg}$).

The radio frequency spectrum, which can be used in the antipersonnel role, must be in the upper GHz region. The emitted wave can have various characteristics:

- Continuous.
- Narrowband.
- Mean and peak power.
- Pulse duration.

Where such weapons are concerned, some technical points are worth detailing for the possible establishment of several sub-categories:

- Single or recurrent shot weapons, using pulses or continuous waves.
- Frequencies.
- Propagation characteristics.

b) Advantages and Disadvantages

Effective through clothing.

Excessive power levels can have serious consequences for human targets.

Possibility to move out of exposure.

The long-term physiological effects of the microwaves received by an individual are still being studied (maximum acceptable dose, cumulative effect of successive exposures). The absence of definitive results is the main obstacle to the use of radio frequencies.

3.3.1.2 Laser

a) Principles and System Description

A laser acting on somebody's eyes modifies their visual capabilities.

The persistence of the effect varies from individual to individual, and the action of weapons for the reversible modification of vision must thus be repeated to maintain an effect over long periods. Note: the use of the same word to cover the concepts of "dazzling" and "blinding" in some languages causes confusion, and so here the term "reversible modification of vision" is associated to "dazzling".

It is important to note that the dazzling laser system can be used both for an anti-materiel and anti-personnel application, namely multi-purpose dazzling laser. The pain generation is obviously an anti-personnel application.

It is also possible to use a laser beam operating outside the visible spectrum between 0.7 and 1.4 microns. A heating of the cornea or the skin can be also realised with a laser beam (wavelength superior to 1.4 microns), namely the hereafter described pain generation laser.

Multi-Purpose Dazzling Laser

For an anti-personnel application, this system induces a reversible modification of the vision (dazzle). It could be combined with a stroboscopic effect to induced additional psychological effect. In order to be sure not to blind, it is necessary to associate the system with a range measure and to be able to control intensity/divergence. This same device can be used for an anti-material optronic countermeasure too.

System aspects : man transportable, fittable on ground and aerial vehicles, energy source is not a problem, easy to combine with other NLW.

Pain Generation Laser

It is an eye-safe laser which generates pain when the beam interacts with the skin (burning sensation without injuries). It can work through light clothes.

System aspects: man transportable, fittable on ground and aerial vehicles, energy source is not a problem, easy to combine with other NLW.

b) Advantages and Disadvantages

The main advantages are accuracy and low weight and small volume. Easy to combine with other NLW and the possibility to have a dual use (anti P/M).

It is important to develop an artificial eye reacting like the human eye for accurate assessment of the weapon. For long-range application, high meteorological conditions dependence. There are possible countermeasures. For anti-personnel special glasses and thick clothes prevent pain on the skin.

3.3.1.3 Electromagnetic Launcher

a) Principles and System Description

An electromagnetic launcher can be used to project various objects.

It is envisaged that an electric device could be launched using such a device.

b) Advantages and Disadvantages

Such a launcher could make it possible to project the objects with controllable energy, depending on the distance and the lethal or non-lethal effect desired.

The main inconvenience of this type of system is that it can only attack a single target at a time.

3.3.1.4 Electromagnetic Mines

a) Principles and System Description

This type of mine could generate a magnetic field which would induce an electric current in a nearby body.

b) Advantages and Disadvantages

Possibility of a mine remote control (on/off) allowing its neutralisation in case of friendly passing over.

3.3.2 Chemical Technologies

a) Principles and System Description

Non-lethal chemical technologies could act on:

- The central nervous system by calmatives, dissociative agents, equilibrium agents.
- The visual sense by smoke generation.
- The sense of smell by malodorous products.
- The respiratory membranes by irritating effect.
- The skin by the irritating effect.
- The nervous system by convulsives.

b) Advantages and Disadvantages

The effectiveness of this technology may vary from individual to individual (no effects at all on some persons). On other persons chemical products can lead to death if applied to persons with a poor physical condition.

Environmental conditions (especially outdoors) must be considered, because the dispersal is wind driven in an outdoor environment. Indoor ventilation systems must be considered as well.

Friendly forces have to wear protective gear which reduces their vision and communication etc.

Countermeasures are possible (gas masks) but cumbersome.

Anti-personnel agents could be delivered at point (zone 1) or at distance (zones 2, 3). Delivery systems could range from aerosol sprays to aerial burst NL-mortar shells. The material could be solid or powders requiring active dispersal or simple gases dispersed by diffusion or winds. Activity could be immediate or delayed by requiring chemical reaction to form the active agent.

3.3.3 Acoustic Technologies

a) Principles and System Description

The human ear is sensitive between 20 Hz and 20 kHz. Non-lethal actions in this field could be deafening targets or emitting disagreeable sounds (psychological effect). With low frequencies, additional effects can be obtained, in particular loss of equilibrium. Directivity can be achieved by different well-known techniques.

Directional Multi-Effects Acoustic System

The aim of the system is to generate different anti-personnel effects: targeted information/desinformation (psychological effect on selected people among a crowd), continuous (or not) unbearable acoustic stress (physical + psychological effects), loss of equilibrium (physiological effect) by the use of low but audible frequencies (effect on internal ear).

System aspects: man transportable (in subassemblies for arrays) and easily fittable on ground or aerial vehicles (inc. unmanned vehicles). The energy source is no major problem (for instance electric generator). They are easy to combine and complementary with other NLW.

b) Advantages and Disadvantages

The advantages are no effect on environment and no known long term effect on health. It is easy to graduate the effect and to select area.

The disadvantages are very high variable individual sensitivity (limitation) and some possible countermeasures e.g. finger in the ears, ear plugs, active noise reduction systems. This reduces crowd activities. The evaluation has to be completed especially on psychological effect and for equilibrium loss.

Low power directional acoustic systems with a range of about 100m already exist.

The effect of this category of weapons depends on the frequency and the waveform.

If well selected, the frequency and power of the weapon can rapidly overcome even highly-motivated individuals. If badly used, on the other hand, they can cause irreversible damage to the hearing apparatus.

Earplugs could reduce the sound level up to 20 dB.

These systems do not necessarily operate in the audible frequency band. The resulting distress only appears at high decibels after a considerable period of time.

3.3.4 Mechanical Technology

3.3.4.1 Rapid Barriers

a) Principles and System Description

A passive means of crowd management could be achieved by the deployment of appropriate rapid barrier technology.

Control may be achieved via fast rising portable, telescopic cylinders between which nets or similar constructions, airbags or plastic films, could be suspended. The system could be fixed to protect permanent assets.

b) Advantages and Disadvantages

The barrier system is seen as an excellent means of deterring the passage or channelling of crowds, or light or soft skinned vehicles and would be an appropriate means of rapidly erecting a manned barricade.

3.3.4.2 Nets & Entanglement Techniques

a) Principles and System Description

Both small groups and individuals may be trapped or denied access to areas or assets by the deployment of nets or other entanglement devices.

Micro wires are thin steel wires compacted under tension. When deployed the wires expand to assume pre-determined geometric shapes formed from a tangle of the wire itself. Expansion ratios of 1:6000 are achievable. When deployed the devices could be used to prevent access by personnel from designated areas. The devices could also be deployed to prevent egress of hostile groups from designated assets.

b) Advantages and Disadvantages

The barrier provided by micro wires has the capability of providing coverage of a very large area from a very small deployable volume. However there are certain restrictions that must be considered when this device is deployed against persons rather than material objects. The concept is best-deployed in open and largely unoccupied areas.

3.3.5 Kinetic Technology

In this paragraph a blunt impact technology is described. The parameters, which apply to the blunt impact technology area, are as follows:

- Weight,
- Shape,
- Velocity,
- Material.

The system required could be extended to cover systems that have the capability to combat either point or area targets.

The main disadvantage of the current blunt impact kinetic technology is that the effect varies with range. At short range, 5m, deployment could be lethal whereas long range, 50m, deployment could be barely effective. Current developments, which take into account the need for a variable muzzle velocity, seek to overcome this deficiency. There is also the requirement to scale the impact according to the characteristics of the target in question. Both the range and the size, physical condition and motivation of the target need to be considered in order to deliver the appropriate energy level. Systems designed to incorporate the type of technology described above need not be larger than a normal rifle.

3.3.5.1 Stun Devices

a) Principles and System Description

Stun devices are intended to incapacitate an individual without excessive force by discharging a high voltage/low amperage electric charge to the individual. The effect is a timely distortion of the nerve system.

Systems could have different shapes, e.g. baton (direct contact), or pistol (firing metal darts connected with wires).

b) Advantages and Disadvantages

Advantages are the small size and weight, the low price, and the controlled use.

Serious effects on health are not known.

Disadvantage is the limited range.

3.3.5.2 Vortex Generator

a) Principles and System Description

A vortex generator could be used for controlling crowds. The device could be transported on a truck or an Armoured Fighting Vehicle (AFV). The vortex created travels at approximately 30 to 50m per second. The device may be considered to have four major effects; acoustic, periodically generated non-lethal shock waves, vortices and it may be used as carriers for irritants. The effective range is about 60m. The technology would be mature in the near future and single and multiple shots are possible.

b) Advantages and Disadvantages

The advantage of the vortex generator is that multiple effects are provided and an escalation of effect to deter an increasing threat is also possible. The disadvantages are associated with the high noise level, which may lead to hearing damage.

3.3.5.3 Airbag Stoppers

a) Principles and System Description

Air bag stoppers could be used to provide immediate barriers to deny access to areas or buildings, such as checkpoints. The technology is seen as an extension of vehicle airbag technology. A detection device or sensor or alternatively a manual, remote control, may trigger the device.

b) Advantages and Disadvantages

The airbag stoppers could be used as a rapidly deployed anti-personnel device for area or entry denial. It may slightly injure personnel when activated.

3.3.5.4 Paint and Dyes

a) Principles and System Description

During many of the operations performed by peace keeping forces it will be desirable to mark or tag individuals or groups for the purposes of identification or later detention and arrest. As discussed before

TECHNOLOGIES OF INTEREST

the type of launcher used for the blunt impact projectile technology may be considered the most promising solution for this task.

Marking individuals may be achieved by a series of means. This may vary from the simple marking of individuals by paint or dye. Other means of identification could be used such as tagging with coded RF tags. These tags could be less than pinhead size and coded with specific data concerning the date, location and time of deployment. Combinations of the effects may also be required to provide a robust means of bringing the particular individual to justice.

b) Advantages and Disadvantages

Paints and dyes can be very difficult to remove. However if covert marking systems are used, for instance those which only become apparent under UV light, the target is unaware of the fact he has been tagged and so is less likely to take action to remove the marker.

Technology is being developed which uses RFID (Radio Frequency Identifiers). Their small size makes these difficult to detect and attachment methods derived from the nature makes them difficult to remove from skin or clothing.

3.3.6 Combined Technologies

a) Principles and System Description

The use of combined technologies reinforces the effect of an anti-personnel NLW.

Several examples are given below:

- Kinetic and acoustic (the vortex):
 - A sizeable vortex generator could theoretically move objects or people. This system would require very much energy, and produces a very great but poorly directional sound effect;
 - A small vortex generator gun could convey chemical products for anti-personnel applications (Marker, tear-gas, malodorous) and anti-equipment (powder of carbons).
- Laser with stroboscopic radiation:
 - A stroboscopic effect of frequency between 7 and 12 Hz can provoke severe discomfort and nausea in a group of persons.
- Different types of laser:
 - The joint use of two laser sources could permit a reversible modification of vision and a local increase in target temperature.

Chapter 4 – LEGAL AND POLITICAL ASPECTS

The purpose of this chapter is to analyse the legal and political implications and constraints associated with the use of non-lethal weapons in the context of present and future peace support operations.

Firstly a general analysis of the applicable legal texts and of the political considerations is made regarding the perception and acceptance of the use of NLWs by the different parties involved in a conflict.

Secondly future trends associated with the legal and political arenas surrounding the use of NLWs are identified. Recommendations for future work are made.

4.1 LEGAL ASPECTS

This work is based on illustrative scenarios in the general framework of a peace support operation mandated by an international organisation (UN or regional organisation acting with UN endorsement). It is assumed that this operation is governed by the law of nations and of international relations, and is thus subject to the Law of Armed Conflict (LoAC) which constitute the legal basis applicable to international and non-international armed conflicts. LoAC neither defines nor makes a distinction between lethal and non-lethal weapons.

Some countries also apply International Human Rights Law (IHRL) generally. This latter is not addressed further in this document. However, it can be noted that both LoAC and IHRL are based on common principles and are aimed at protecting persons against arbitrary and unnecessary cruel treatment.

4.1.1 Law of Armed Conflicts (LoAC)

Customary law and treaty law are the main sources of LoAC. Although some treaties have not been ratified by all states, some of their provisions are considered customary international law. A list of the states which have ratified or filed their intention to ratify each convention is kept up to date in regards to each convention. The United Nations maintains a set of lists of the States which have ratified all the conventions coming under its aegis.

Unlike treaty law (e.g. the four Geneva Conventions), customary international law is not written. A rule is customary if it reflects state practice and when there exists a conviction in the international community that such practice is required as a matter of law (*Opinio Juris*). The International Committee of the Red Cross (ICRC) is preparing a report on customary rules of LoAC applicable in international and non-international armed conflicts, which will be published in 2004.

LoAC protects civilians and civilian objects which are, or may be, directly affected by an armed conflict or situations of occupation. The rules of LoAC also cover aspects such as the conduct of hostilities, the status of combatants and prisoners of war, and the protection of the emblems of the Red Cross, the Red Crescent and the Red Lion.

Principles of LoAC

- The principle of military necessity: it justifies those measures not forbidden by international law, which are indispensable for securing the complete submission of the enemy as soon as possible.
- The prohibition of superfluous injury or unnecessary suffering.

LEGAL AND POLITICAL ASPECTS

- The principle of distinction: the parties to a conflict must at all times distinguish between combatants and non-combatants, and between military and non-military targets. Neither the civil population as a whole nor civilians in particular may be subjected to attacks.
- The principle of proportionality: it is forbidden to attack a military target if such an action would cause excessive damage to civilians and civilian objects.

Furthermore the right of the parties to a conflict to choose methods and means of warfare is not unlimited.

In cases not covered by LoAC, the Martens clause applies. This mandates that civilians and combatants remain under the protection and authority of the principles of international law derived from established custom, from the principles of humanity and from dictates of public conscience.

LoAC binds all parties to an armed conflict. In an international conflict it must be observed by the belligerent states. In an internal conflict it binds the state and the groups fighting against it or fighting among themselves. Thus LoAC establishes rules which are applicable to states and non-state factions, groups or other parties.

The main LoAC treaties applicable to NLWs are listed below. Not all NATO nations are parties to these treaties, although some of their provisions are considered customary international law by different states. Differing national views will have to be considered in all NATO missions.

1868 Saint Petersburg Declaration Renouncing the Use, in Time of War, of certain Explosive Projectiles.

In the preamble to this declaration, the following considerations can be noted:

- The only legitimate object which States should endeavour to accomplish during war is to weaken the military forces of the enemy.
- For this purpose it is sufficient to disable the greatest possible number of men.

1899 The Hague, Declaration (IV,3) concerning Expanding Bullets.

The declaration prohibits the use of bullets which expand or flatten easily in the human body.

1907 The Hague Convention (IV) respecting the Laws and Customs of War on Land and its Annex: Regulations concerning the Laws and Customs of War on Land.

This convention limits the right of belligerents to adopt means of injuring the enemy.

In addition, it particularly forbids:

- The employment of poison or poisoned weapons.
- The employment of arms, projectiles, or material calculated to cause unnecessary suffering.

1925 Geneva Protocol/ Protocol for the Prohibition of the Use in War of Asphyxiating, Poisonous, or Other Gases, and of Bacteriological Methods of Warfare.

In response to the use of poisonous gases in the First World War, this protocol prohibits further use of such chemical weapons as well as biological weapons. The protocol only concerned their use between states and did not cover internal or civil conflicts.

The Protocol recognised the significance of bringing together controls on chemical and biological weapons. While it prohibits the use of such weapons it does not prohibit their production, development

and stockpiling. Additionally many state-parties held reservations to the protocol as to the right of retaliatory use, making it effectively a no-first-use treaty for those states, hence the need for further treaties which came in the form of the 1972 Biological and Toxin Weapons Convention (BTWC) and the 1993 Chemical Weapons Convention (CWC).

There is no verification mechanism contained within the protocol and compliance is voluntary.

The four Geneva Conventions dated 12 August 1949 and their additional Protocols I and II dated 8 June 1977.

The four Geneva Conventions of 1949 and their two Additional Protocols of 1977 are principal instruments of LoAC. Applicable in case of international armed conflict, the four Geneva Conventions of 12 August 1949 concern the treatment of:

- The wounded and sick in armed forces in the field (Convention I);
- The wounded, sick and shipwrecked members of armed forces at sea (Convention II);
- Prisoners of war (Convention III);
- Civilian persons (Convention IV).

The latter includes internally displaced persons, women, children, refugees, stateless persons, journalists and other categories of individual.

Two additional protocols complement the Geneva Conventions:

- The Protocol Additional to the Geneva Conventions of 12 August 1949, and relating to the Protection of Victims of International Armed Conflicts (Protocol I), 8 June 1977.
- The Protocol Additional to the Geneva Conventions of 12 August 1949, and relating to the Protection of Victims of Non-International Armed Conflicts (Protocol II), 8 June 1977.

Protocol I includes rules governing the conduct of hostilities include prohibitions regarding weapons and methods and means of warfare:

“Article 35 – Basic rules

- 1) *In any armed conflict, the right of the Parties to the conflict to choose methods or means of warfare is not unlimited.*
- 2) *It is prohibited to employ weapons, projectiles and material and methods of warfare of a nature to cause superfluous injury or unnecessary suffering.*
- 3) *It is prohibited to employ methods or means of warfare which are intended, or may be expected, to cause widespread, long-term and severe damage to the natural environments.”*

Article 36 of Protocol I relating to the protection of victims of international armed conflicts lays conditions on the development of new weapons. This article is reproduced in full below:

“Article 36 – New weapons

In the study, development, acquisition or adoption of a new weapon, means or method of warfare, a High Contracting Party is under an obligation to determine whether its employment would, in some or all circumstances, be prohibited by this Protocol or by any other rule of international law applicable to the High Contracting Party.”

LEGAL AND POLITICAL ASPECTS

This article implies that all states parties are obligated to institute a national legal review process for all new weapons whether lethal or non-lethal. Each state party is free to choose its review mechanism. In consultation with states, the ICRC is developing guidelines which can assist state parties in establishing their legal review mechanisms.

Protocol II applies to “all armed conflicts which are not covered by Article 1 of the Protocol Additional to the Geneva Conventions of 12 August 1949, and relating to the Protection of Victims of International Armed Conflicts (Protocol I) and which take place in the territory of a High Contracting Party between its armed forces and dissident armed forces or other organised armed groups which, under responsible command, exercise such control over a part of its territory as to enable them to carry out sustained and concerted military operations and to implement this Protocol.” (Article 1).

Additional Protocol II does not apply to “situations of internal disturbances and tensions, such as riots, isolated and sporadic acts of violence and other acts of a similar nature, as not being armed conflicts.” (Article 2).

Convention of 10 April 1972 on the Prohibition of the Development, Production and Stockpiling of Bacteriological (Biological) and Toxin Weapons and on their Destruction.

This Convention prohibits all bacteriological (biological) and toxin weapons. Article 1 of this Convention is as follows:

“Each State Party to this Convention undertakes never in any circumstance to develop, produce, stockpile or otherwise acquire or retain:

- 1) Microbial or other biological agents, or toxins whatever their origin or method of production, of types and in quantities that have no justification for prophylactic, protective or other peaceful purposes.*
- 2) Weapons, equipment or means of delivery designed to use such agents or toxins for hostile purposes or in armed conflict.”*

Although BTWC comprehensively prohibits misuse of biological and toxin materials, it has no associated verification regime.

Convention on the Prohibition of Military or any Other Hostile Use of Environmental Modification Techniques, 10 December 1976 (ENMOD Convention).

The ENMOD Convention is an instrument of international law aimed specifically at protecting the environment in a situation of hostilities. It prohibits the hostile use of the environment as a method of combat. The provisions of Additional Protocol I of 8 June 1977 to the Geneva Conventions of 1949 which directly prohibit causing damage to the environment in warfare provide an essential complement to ENMOD.

Other rules and principles of LoAC also provide protection for the environment in armed conflict, although they may not mention it specifically. In particular, general custom governing the conduct of hostilities includes the principle of discrimination, which limits attacks to military objectives, and the principle of proportionality, which prohibits the use of means and methods of combat causing excessive damage.

United Nations Convention of 10 October 1980 on Prohibitions or Restrictions on the Use of Certain Conventional Weapons which may be deemed to be Excessively Injurious or to have Indiscriminate Effects and its Protocols.

This Convention applies two general customary rules of LoAC to specific weapons, i.e.:

- The prohibition on the use of weapons which have indiscriminate effects.
- The prohibition on the use of weapons which cause superfluous injury or unnecessary suffering.

This Convention, while applying customary rules to specific weapons, does not restrict states' obligation to refrain from using weapons which are not mentioned in it, but which would nevertheless violate LoAC. It forms a framework complemented by four Protocols governing the use of specific weapons. New protocols may be added when the States parties deem it necessary. There are currently four protocols to this Convention:

- Protocol I – Non-detectable fragments.

It is prohibited to use any weapon the primary effect of which is to injure by fragments which in the human body escape detection by x-rays.

- Protocol II – Mines, booby-traps and other devices.

This protocol regulates and restricts the use of mines, booby-traps and other devices.

- Protocol III – Incendiary weapons.

Incendiary weapons are those which are primarily designed to set fire to objects or to cause burn injury to persons through the action of flame or heat, for example flame-throwers (Article 1).

They should not in any circumstances be used against civilians, or be delivered by aircraft against military objectives located within concentrations of civilians. Furthermore they may not be used against forests or other kinds of plant cover, except when such natural elements are used to conceal or camouflage combatants or other military objectives (Article 2).

- Protocol IV (Vienna Protocol) – Blinding laser weapons

It is prohibited to use, or to transfer to any state or any other entity, laser weapons specifically designed to cause permanent blindness to unenhanced vision (Article 1).

In the employment of laser systems, parties shall take all feasible precautions to avoid permanent blindness. Such precautions shall include training of their armed forces and other practical measures (Article 2).

Convention of 13 January 1993 on the Prohibition of the Development, Production, Stockpiling and Use of Chemical Weapons and on Their Destruction (CWC).

This Convention aims to completely exclude the possibility of use of chemical weapons by prohibiting their development, production and stockpiling and by destruction of stocks and existing production facilities. Like the 1972 Convention on bacteriological weapons, in several ways it complements and strengthens the Geneva Protocol of 1925 on the Prohibition of the Use in War of Asphyxiating, Poisonous or Other Gases, and of Bacteriological Methods of Warfare.

Besides the fact that it does not allow any reservations (Article XXII¹), the Convention extends the prohibition on the use of chemical weapons to their development, production, acquisition, stockpiling, retention and transfer, as well as requiring both their destruction and that of the facilities where they are produced. Unlike the BTWC, compliance with the CWC is verifiable through the requirements for declaration by state parties and the associated inspection activities of the Organisation for the Prohibition of Chemical Weapons (OPCW).

¹ Article XXII – Reservations: The Articles of this Convention shall not be subject to reservations. The Annexes of this Convention shall not be subject to reservations incompatible with its objects and purpose.

LEGAL AND POLITICAL ASPECTS

The CWC prohibits chemical weapons, including those that cause temporary incapacitation. Therefore, non lethal chemical weapons seemingly are prohibited. However, the use of a chemical agent for law enforcement including domestic riot control purposes is a non-prohibited purpose.

The CWC also prohibits the use of Riot Control Agents (RCAs) as a “method of warfare”.

The CWC does not define the terms “law enforcement purpose” or “method of warfare”.

The CWC allows for a review conference to take into account scientific and technological developments. It takes place every five years. The next one is due in 2008.

Convention on the Prohibition of the Use, Stockpiling, Production, and Transfer of Antipersonnel Mines and on their Destruction, 18 September 1997 (Ottawa Convention).

The states which sign the treaty undertake *never, under any circumstances, to use, develop, produce, otherwise acquire, stockpile, retain or transfer antipersonnel mines, nor to assist anyone to do so.*

For the purposes of this convention, antipersonnel mines are defined as “*designed to be placed under, on or near the ground... and to be exploded by the presence, proximity or contact of a person...*”

Only antipersonnel mines are prohibited by the Ottawa treaty.

It does not cover:

- antitank and anti-vehicle mines (whose use is regulated by the United Nations Convention of 1980 on certain conventional weapons, and by the general principles of LoAC).
- anti-handling devices fitted to anti-vehicle mines to prevent their removal.
- Remote-controlled devices which can only be triggered manually by a combatant, and not simply “by the presence, proximity or contact of a person”.
- Maritime mines.

4.1.2 Terms of the Mandate Given to the Force and Rules of Engagement (ROE)

The terms of the mandate given to a particular force define its political and military objectives and the freedom of action and autonomy granted to it. They also define the legal framework for the use of force, taking into account the different bodies of law applied by the states belonging to the coalition providing the force and by the state in which the coalition is intervening. They also establish the legal status of the forces deployed.

The rules of engagement (ROE) are guidelines for the use of force. However, the soldiers of a coalition are primarily subject to the laws of their country of origin. It should be noted that ROE are a point of convergence between the political, military and legal aspects, where the sensitivities of each nation of the coalition may diverge on such specific points as the right of self-defence or the notion of a threat.

4.1.3 Labour Law

The use of certain non-lethal weapons may expose their operators to the same effects as the targets, but at lower intensities (microwave NLW, for example). The results for their health and the possible legal consequences do not fall under the law of armed conflict but rather under national legislation for health and safety at work and the protection of labour.

This national legislation therefore has relevance in the consideration of NLWs.

4.2 POLITICAL CONSIDERATIONS

4.2.1 Political Aspects

Whatever the situation, the use of armed force to settle international differences always result from a clash between different wills. Despite legal norms addressing the use of weapons, the perception of whether the means employed in the conflict are acceptable may vary considerably depending on the political actors involved.

Under the UN Charter, armed interventions may only take place with authority given by the UN Security Council, or in self-defence or collective self-defence. The great majority of the democracies want a legal basis for their actions, all the more so as the opposing blocs have disappeared. Thus force is used in a framework involving more constraints arising from the terms of the mandate, compounded by the obligation to respect international law. These imperatives apply to the entirety of the military operations, from the choice of targets to the establishment of post-crisis stabilisation arrangements.

NATO forces might be involved in conflicts caused by many factors, including:

- Extreme nationalism.
- Religious fundamentalism.
- Ethnicity.
- Economic deprivation.
- Access to resources.

For some actors, these factors may easily justify infringements of LoAC and IHRL, all the more so as a clash with an international coalition is often an obviously asymmetrical conflict. They may justify such infringements as the necessary response of the weaker side to the stronger. The people living in countries controlled by such actors have little influence on the course of the war as any potential opposition is rapidly silenced. They are often morally excused of responsibility by world public opinion, strengthening the perception that they are the principal victims of the conflict.

The perception of the hostilities and the acceptable level of violence are thus very different depending on the political regimes or actors concerned. However, the democracies cannot easily justify escalation in response to unconventional attacks, even those using prohibited weapons, as it remains the concern of Western political leaders to obtain the widest possible approval from the national and international communities. Now this approval depends very directly on the legitimacy of the means used – in their form, in their intensity and in the targets attacked.

The political leaders of the democracies thus face the obligation to achieve the political aims of the conflict, which are generally determined by the mandate received, while permanently restricting the level of violence whatever the methods used by the adversary. The range of choice of means and targets offered by the military is vital for the political authorities. By making their choice, they must signal their determination to the enemy while showing international opinion their concern to observe the applicable law.

4.2.2 Armed Forces

At the strategic level the armed forces engaged are burdened on the one hand with the obligation to succeed and on the other with the duty to respect the law and the conventions applicable. These two aspects will partly determine the choice of means used, ultimately decided by the political authority.

At the operational and tactical levels it is more difficult to implement these choices. At the same time it will be necessary to weigh the proportionality of the means envisaged relative to the threat they are supposed to counter, their operational effectiveness, the intended targets, the risk of not controlling their effects, and the legality of the response under the law and the ROE, all taking account of the actions and means adopted by the adversary.

A further distinction must be applied to the military forces responsible for ensuring public order during the restoration of peace after the height of the crisis. At this point the aims pursued change. In the height of the crisis, the priority is to impose control. During restoration of peace, the priority is to contain latent violence while avoiding destruction. This will modify the criteria determining the acceptability of the means used, restricting several means at least as regards collateral damage, persistence of effect and reversibility; and on the other hand, potentially allowing other ones like RCA, which are prohibited on a battle field as a method of warfare.

4.2.3 Non-State Actors

Non-state actors have always been a part of conflicts. However the role and nature of non-state actors, and the potential threats posed by them, is changing. Besides the occurrence of non-state actors as potential adversaries for states, non-state actors also play a greater role within (internal) conflicts. Military forces in an operation may be confronted with terrorists, piracy, mercenaries, armed bands, militia or criminals.

A difficulty is how to categorise those formations in legal terms.

Qualification as a non-state actor does not bring exemption from observing LoAC and IHRL. Even in an armed conflict which is not international the parties are bound to apply, as a minimum, certain provisions of LoAC and IHRL (such as Common article 3 to the Geneva Conventions).

Furthermore, in a non-international armed conflict, as soon as non-state actors take the form of organized armed groups which are, “under responsible command, exercise such control over a part of [the] territory as to enable them to carry out sustained and concerted military operations and to implement this Protocol”, they must conform with Additional Protocol II to the Geneva Convention. (Article 2 of the Additional Protocol).

4.2.4 Public Opinion in the Nations Taking Action

Finally, the democracies are morally accountable to their populations for the human losses suffered by their forces. Without going as far as the fallacious concept of a “zero-death war”, it is indisputable that high losses can cause a change in national opinion if the vital interests of the nation are not directly at stake in the conflict.

The acceptance of armed conflict by democratic populations is very variable depending on the socio-cultural heritage of the democracy in question. Here we will discuss the criteria determining the acceptability of the means used, and not the legitimacy of the conflict itself or its primary political aims, which fall in a different sphere.

The acceptance of the means used depends in the first place on the targets attacked. Human losses among opposing soldiers are more or less considered normal when they result from the use of unprohibited weapons under allowed conditions. There are however limits to this acceptance, for example when entire units which have not agreed to surrender are destroyed.

In the second place, the parameters of proportionality, concern about collateral damage, preservation of non-military objects and civil population will be largely preponderant since, according to a widely-held

view, war and its direct effects should remain a matter for the combatants. This is all the more true because, in the typical conflicts of today, even before the start of hostilities the people are already the victims either of dictatorial regimes or of factional fighting. The effort to assist the people who are the victims of the conflict is furthermore an important factor of acceptance by public opinion.

In the last place, public opinion will be better able to accept certain difficult aspects of the conflict if it has been educated to do so and if a minimum of transparency is respected. The role of the media in this area is vital.

4.2.5 Non-Governmental Organisations

The NGOs are entirely oriented towards assisting the population. They generally disapprove of any armed intervention except when it is established that genocide is imminent or already happening, that a human catastrophe has begun (deliberately provoked famine, forced population movements, large-scale natural disaster, etc) or that the lack of security on the spot no longer allows them to carry out their functions.

In addition, NGOs do not always think that military intervention is appropriate to the extent that the presence of forces, particularly when one of the missions of those forces is to further the humanitarian action of the NGOs, may run counter to their duty of impartiality towards the parties involved in the conflict. Finally, they often believe that military logistics are not suited to providing humanitarian relief.

As they have to deal with the long-term consequences of conflicts during the phases of rebuilding the peace, NGOs have a good practical vision of the persistence of the effects of certain weapons on the population, the infrastructure and the environment. Thus it is not surprisingly that they continuously campaign for ever tighter regulation of weapons which have lasting effects.

For the NGOs, the acceptability of the means used during the conflict will depend firstly on the collateral effects on the population, whether they are direct (harm to persons and to health in general) or indirect (damage to objects, to the economy, to the civil infrastructure and to the environment).

4.2.6 The Media

The role of the media in conflicts is of vital importance for the political leaders. It is the media which have most influence on public opinion. However, in time of conflict the work of the media is often counter to the requirements of security of the forces engaged, which generally places the military command in a difficult position. The press rapidly denounces any attempt of the commanders to restrict access to the combat areas or of the military press services to accompany the journalists too closely as so many obstructions to the freedom of information.

The handling of information by the media will be all the more objective if transparency has been observed when this information is gathered, of course on condition that minimum professional standards are followed by the media.

As the media's priority is to provide information meeting the interests of the reader, listener or viewer, for obvious commercial reasons, the main focus of the information should be on the effects of the conflict rather than on the operations themselves. Firstly because gathering information directly from combat operations brings considerable risks, secondly because military information sources are not as accessible as the press would desire, finally because public opinion is more sensitive to the effects of the conflict on the people than on the combatants themselves.

Thus, in advance of public opinion, the criteria of acceptability to the media will most often be very close to those of public opinion or the NGOs. In particular, the media will widely broadcast any infringement of LoAC.

4.3 CONSIDERATIONS RELATING TO SCENARIOS

The aim of this paragraph is, for each combination of target and candidate technology, to establish the legal and political factors likely to determine the possible future use of certain non-lethal means. The combinations considered to start with have been developed in previous chapters on the basis of technical and operational factors.

The political and legal aspects are analysed in relation to the following parameters.

Current legal constraints:

- All the texts currently applicable to the use of a candidate technology in a given context.

Current political constraints:

- Involved parties which must be considered when assessing the acceptability of the use of a candidate technology in a given context.

Future legal constraints (trends):

- Probable evolution of legal constraints on the basis of current trends.

Future political constraints (trends):

- Probable evolution of political constraints on the basis of current trends.

The Annex E presents a table-type document including the matching of the targets and the candidate technologies.

Chapter 5 – CONCLUSIONS AND RECOMMENDATIONS OF THE MULTINATIONAL EXERCISE

The aim of this chapter is to summarise all the thinking based on this preparatory document during the week of the MNE.

The results of the consensus arrived at during discussions have been incorporated in the working tables relating to the different scenarios analysed.

The next two paragraphs below will provide a summary of the discussions and exchanges of view between the different experts participating in the work.

The technologies selected as the most relevant in all the fields analysed will be highlighted in the paragraph devoted to the overall conclusions.

5.1 CONCLUSIONS

5.1.1 Operational and Technological Conclusions

Scenarios facilitated analysis of how best to accomplish assigned mission tasks and satisfy target and collateral constraints. This provided the foundation for an assessment of which basic capabilities would be of highest likelihood, impact, and NLW relevance in the 2020 timeframe:

- Deny persons from accessing an area.
- Rescue individuals/groups.
- Deny ground, air and sea vehicles from accessing an area.
- Neutralise ground vehicles.
- Protect facilities and equipment.
- Neutralise infrastructure and facilities.
- Neutralise communications (this was not one of the items on the basic capabilities list, but it was a supporting capability desired in nearly every scenario).

Using a structured approach for organising subject matter expertise (both operational and technological), SAS-040 identified five technologies/capabilities that best matched the requirements associated with the key basic capabilities:

- RF devices.
- Rapid barriers (acoustic, electro magnetic mechanical).
- Anti traction.
- Stun devices.
- Nets.

SAS-040 then compared operational requirements – range, onset, and duration – versus projected technology capabilities in 2020 (provided that R&D investments and system development efforts are consistent with the forecasts of technology subject matter experts). The results of these comparisons are shown in the table below. A colour coding of Green indicates that the technology is projected to meet the

CONCLUSIONS AND RECOMMENDATIONS OF THE MNE

requirements for range, onset, or duration across scenarios. A colour coding of Yellow indicates that the technology meets some but not all of the requirements for range, onset, or duration across scenarios. A colour coding of Red (not a result for any of the technologies in the current assessment) indicates that the technology fails to meet most of the requirements for range, onset, or duration across scenarios.

Technology trends show that systems will be more compact, lighter and hardened and will possess increased target range, area of effect and target discrimination capabilities.

	RF devices	Anti-traction	Rapid Barriers	Stun Devices	Nets
Range	Green	Yellow	Yellow	Yellow	Yellow
Onset	Green	Yellow	Yellow	Green	Green
Duration	Green	Green	Yellow	Green	Yellow

Estimated Ability to Meet 2020 Military Requirements

These 5 technologies represent a mix of advanced technologies (with electromagnetic weapons having especially high potential for growth) and low technologies. These and other non-lethal technologies can be used in combination with each other to increase effectiveness and resistance to countermeasures and could be made scalable from non-lethal to lethal.

5.1.2 Legal and Political Conclusions

Although potential legal developments can only be identified on a case by case basis, several general legal issues may arise in the context of the development and use of NLWs. These issues are listed hereafter:

- Determination of the Legality of NLWs***
States have an obligation to determine the legality of new weapons (e.g. Article 36 of protocol I additional to the 1949 Geneva conventions). A proposal of guidelines for such legal review is provided in Annex C. This legal review is meant to determine whether a new system is lawful and to ensure the legality of its use at the time of employment.
- NLWs and Target Discrimination***
The use of NLW can possibly be a means to cope with the changing nature of operations (operations against non-state actors, mix of combatants and non-combatants). In particular, NLWs can help minimise incidental injuries to civilians and collateral damage to civilian objects in those operations where combatants and non-combatants are mixed. The existence of NLWs should not be construed as to lessen the requirements of the principle of discrimination.
- Consequence of NLWs on the Potential Use of Lethal Weapons***
In accordance with current NATO policy, NLW will continue to be complementary to (and will not replace) lethal weapons. There is no legal obligation to resort to non-lethal force when lethal force is authorised and today there is no foreseeable reason why this may change in the future.
- Use of Force Spectrum***
Irrespective of the development of NLW technologies, the use of force will continue to remain commensurate to the threat posed. In addition, similar to conventional force, NLWs must not be used in self-defence unless there is a threat posed.
- Criteria for Participation to NATO Peace Support Operations***
For some NATO member states, the use of NLWs in an operation could be a factor for participation.

- ***Risk of Escalation***

The use of NLWs can be a mean to de-escalate the level of violence. However, the introduction of NLWs may lead to an increase of the resort to the use of force, thus increasing the risk of escalation. In addition, the use of NLWs rather than lethal force may provide less of a deterrent value.

- ***Prevention of Misuse of NLW***

The technologies used in providing a NLW capability are not necessarily in their own right “non-lethal”. Depending upon the context and circumstances, some may be misused for illegal purposes.

- ***NGO’s Interest for NLWs***

As with other weapon issues (e.g. anti-vehicle mines, cluster bombs), NGOs will undoubtedly show interest in NLW, especially in emerging or developing technologies, including in their legal framework.

- ***Legal Consequences of the Use of NLWs***

As for any other method or means of warfare, cases involving the use of NLWs may be subject to criminal investigations and judgements by domestic or international courts. Furthermore, the ability to capture and prosecute could be made easier by the use of NLWs.

5.2 RECOMMENDATIONS

5.2.1 Operational and Technological Recommendations

Based on the assessment work that took place during SAS-040 and the conclusions described above, there are two major recommendations associated with matching technology development to NATO’s future military requirements:

- Invest in R&D programmes on RF and Stun devices in order to satisfy key 2020 military requirements;
- To fully satisfy 2020 requirements with Anti-traction, Rapid Barriers & Nets, more rapid research progress and additional research investments would be needed.

Other Issues

A number of other issues arose during the course of discussion that merit further consideration:

- ***Testing:*** Assessing target effects (especially long-term human effects) is not only a legal, ethical and political issue, it also affects technology development and an understanding of operational effectiveness.
- ***Doctrine:*** New technologies necessitate the revision and/or development of new concepts, doctrine, tactics, and procedures; and this is true for non-lethal technologies as well. In order to realise the potential of non-lethal capabilities, efforts are needed not only to develop but also to experiment with new concepts, doctrine, tactics, and procedures.
- ***Organisation:*** Two distinct paths are available. Either lethal and non-lethal capabilities can be integrated (at the system and/or unit levels) or these capabilities can be kept separate. There are different views as to which path is the most desirable. The advantages and disadvantages of each path should be assessed in order to assist future NATO and national decisions on the best way to organise.
- ***Training:*** Over time (and this will likely be the case by 2020), NLW training will be viewed in the same light as training with conventional weapons. Until that level of awareness is achieved, however, special efforts will be needed in individual, unit, and staff training to determine the best

use of non-lethal capabilities and to integrate these capabilities with conventional capabilities (lethal, electronic warfare, etc.).

- **Targeting:** Targeting will become more challenging due to complex environments and the close mix of combatants and non-combatants. To achieve accurate targeting and effective target discrimination improved sensors would be needed.
- **Battle Damage Assessment:** Non-Lethal Weapons pose special challenges because of the nature of their effects and the limited duration of the target response.

5.2.2 Legal and Political Recommendations

- **Current LoAC regarding NLWs**

It is essential to determine whether current LoAC adequately addresses the use of NLWs. Considering the wide variety of NLWs, this can only be dealt with on a case by case basis. In this context, it is necessary for NATO member states to work towards a common understanding regarding the application of existing treaties and conventions to NLW. A NATO working group could be settled to deal with this issue.

- **Datasharing on NLW Effects**

In order to comply with their obligation to determine the legality of new weapons, states should aim to collect sufficient and reliable information about the effects of NLWs. The procedures for testing NLWs are different for each nation. For this reason, better data sharing regarding the short-term and long-term effects of NLWs on human beings is needed. Moreover it might be useful to develop a common NATO Standard of even facility for the testing of NLWs.

- **Effect on Escalation/De-Escalation**

The new level of force use introduced by NLWs will certainly have an effect on escalation and de-escalation of the level of violence on theatre of operations. This effect, which is not well known yet needs further research.

- **Need for Interoperability**

Because of the multinational nature of NATO operations, there will be a need to develop a common NATO standard for the use of NLWs and training of personnel. This might also imply changes in the domestic law of some NATO member states.

- **Proliferation of NLW**

The NATO member states should protect against the proliferation of NLW technology for illegitimate purposes through their inclusion in existing export control regimes, adequate reflection within other arms control mechanisms, and through education to promote their responsible use.

- **Resist Constraints on Military Effectiveness**

In order to ensure that NATO forces retain the ability to accomplish missions, it will be important that nations participating in NATO operations remain vigilant against the development of specific legal regimes which unnecessarily limit the ability to use NLWs.

- **Public Acceptance**

In order to garner public and NGOs acceptability of NLW use, it is essential to provide information and give opportunities for constructive debate. In particular, those NLWs other than kinetic and pyrotechnic devices will have to be assessed carefully with regard to their effects on human health (including on both the user and the target) in order to convince public opinion that they do not produce new unknown, including long-term, effects.

Annex A – LIST OF ABBREVIATIONS

BTWC	Biological and Toxin Weapons Convention
CNAD	Conference of National Armament Directors
COTS	Commercial off the Shelf
CWC	Chemical Weapons Convention
EMP	Electro Magnetic Pulse
ENMOD	Convention on the prohibition of military or any other hostile use of environmental modification techniques
ICRC	International Committee of the Red Cross
IHRL	International Human Rights Law
LOAC	Law of Armed Conflict
LTSS	Long-Term Scientific Study
MNE	Multinational exercise
NATO	North Atlantic Treaty Organisation
NGO	Non-Governmental Organisation
NLW	Non-Lethal Weapons
PVAB	Portable Vehicle Arresting Barrier
RCA	Riot Control Agent
ROE	Rules of Engagement
RTO	Study, Analysis and Simulation
TOR	Terms of Reference
UNHCR	United Nations High Commissioner for Refugees

ANNEX A – LIST OF ABBREVIATIONS



Annex B – NATO POLICY ON NON-LETHAL WEAPONS

PURPOSE

- The purpose of this document is to establish NATO Policy for Non-Lethal Weapons.
- This policy applies to all NATO Non-Lethal Weapon research, development and acquisition programmes, employment of Non-Lethal Weapons, and related activities. It does not apply to information operations or any other military capability not designed specifically for the purpose of minimising fatalities, permanent injury to personnel, and undesired damage to property and the environment, even though they may have these effects to some extent.

DEFINITION

- The following definition is applied as far as this policy is concerned:
Non-Lethal Weapons are weapons which are explicitly designed and developed to incapacitate or repel personnel, with a low probability of fatality or permanent injury, or to disable equipment, with minimal undesired damage or impact on the environment.

NATO POLICY

- It is NATO policy that Non-Lethal Weapons, relevant concepts of operations, doctrine and operational requirements shall be designed to expand the range of options available to NATO Military Authorities. NLW are meant to complement the conventional weapons systems at NATO's disposal.
- Non-Lethal Weapons should enhance the capability of NATO forces to achieve objectives such as (not necessarily in order of priority) to:
 - accomplish military missions and tasks in situations and conditions where the use of lethal force, although not prohibited, may not be necessary or desired;
 - discourage, delay, prevent or respond to hostile activities;
 - limit or control escalation;
 - improve force protection;
 - repel or temporarily incapacitate personnel;
 - disable equipment or facilities;
 - help decrease the post-conflict costs of reconstruction.
- The availability of Non-Lethal Weapons shall in no way limit a commander's or individual's inherent right and obligation to use all necessary means available and to take all appropriate action in self-defence.
- Neither the existence, the presence nor the potential effect of Non-Lethal Weapons shall constitute an obligation to use Non-Lethal Weapons, or impose a higher standard for, or additional restrictions on, the use of lethal force. In all cases NATO forces shall retain the option for immediate use of lethal weapons consistent with applicable national and international law and approved Rules of Engagement.
- Non-Lethal Weapons shall not be required to have zero probability of causing fatalities or permanent injuries. However, while complete avoidance of these effects is not guaranteed or expected,

ANNEX B – NATO POLICY ON NON-LETHAL WEAPONS

Non-Lethal Weapons should significantly reduce such effects when compared with the employment of conventional lethal weapons under the same circumstances.

- Non-Lethal Weapons may be used in conjunction with lethal weapon systems to enhance the latter's effectiveness and efficiency across the full spectrum of military operations.
- NATO planners shall ensure that the potential contribution of Non-Lethal Weapons is taken fully into account in the development of their plans.
- Non-Lethal Weapons shall conform to the definition contained in Section II above and have, as a minimum, the following characteristics:
 - They must achieve an appropriate balance between the competing goals of having a low probability of fatality or permanent injury, with minimal undesired damage, and a high probability of having the desired effects.
 - They must not be easily defeated or degraded by hostile countermeasures once known or, if they could be so defeated, the benefits of a single opportunity to use such a weapon in a given context would, nevertheless, be so great as to outweigh that disadvantage or any risk of consequent escalation.
 - The research and development, procurement and employment of Non-Lethal Weapons shall always remain consistent with applicable treaties, conventions and international law, particularly the Law of Armed Conflict as well as national law and approved Rules of Engagement.

ADDITIONAL POLICY GUIDANCE

- Any future request for additional policy guidance shall be referred to the North Atlantic Council.

Annex C – GUIDELINES FOR LEGAL REVIEW OF NLWs

States have an obligation to check the legality of new weapons. This legal review should at least include the following elements for analysis.

I – Is the new weapon lawful?

1) Can it cause “unnecessary suffering and superfluous injury”?

“Unnecessary suffering and superfluous injury” are undefined in international law. The LoAC recognises that suffering will take place on the battlefield. However, disproportionate suffering with regard to the achievement of the military objective is unlawful.

Generally, NLW by definition, should not violate this principle. However, new technologies such as directed energy weapons, laser technologies or electrical devices must be carefully reviewed for their human effects, both in the short term and in the long term. A multidisciplinary approach including legal, military, technical and medical expertise is recommended.

2) Is the new weapon indiscriminate in its effect?

The obligation to discriminate between combatants and civilian persons and objects is a fundamental principle of the law of armed conflict. Weapons with indiscriminate effects are prohibited. Every weapon system must be able to be controlled in such a way as to be directed at a lawful military objective.

Most NLW are discriminate. However, some technologies will need to be addressed. For instance, the use of a High Power Microwave system to disrupt enemy communications within a city that could also impact a hospital in the vicinity of the military objective could be indiscriminate.

3) Specific rules of law

The individual review of specific technologies is necessary. There is no legal impediment to the development of NLW. Specific NLW might be impacted by one or several of the conventions enumerated in paragraph 4.1.1 of the main body. For example, NLW based on toxic chemicals will be governed by the 1993 Chemical Weapons Convention. They will need to be developed with this Convention in mind.

NLW, as well as conventional weapons, may have an impact on environment and will have to be reviewed with reference to the appropriate conventions.

Today, most NLW are not covered by a specific convention. In the future, some of them may be subject to new/special treaties because of their working principles and effects.

Some of the proposed systems are based on laser technologies. Protocol IV of the 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 only prohibits lasers that are specifically designed to cause permanent blindness to unenhanced vision. Therefore, dazzling lasers and laser-transported electrical means would not be prohibited under this protocol.

Additionally, each nation will have to ensure respect for domestic law (e.g. labour law).

II – How to ensure the legality of the use of the new weapon at the time of employment?

Like any weapon, the military commander has to ensure the legality of the use of the new weapon at the time of employment. This includes the following issues:

- Is the target a lawful military objective?
- Are there civilians or civilian objects in the vicinity of the military objective?
If so, precautions have to be taken to minimise excessive damages to civilians or civilian objects.

Annex D – LIST OF PARTICIPANTS

DENMARK

DIEMAR, Maj. M.G.

Defence Command Denmark
SEK Force Plans Branch
Henrikshols Alle
PO Box 202
DK-2950 Vedback
Denmark

Tel: [45] 45 67 43 22
Fax: [45] 45 67 43 09
e-mail: plstaben@fko.dk

KRARUP-HANSEN, Mr. N.

Danish Defence Research Establishment
Ryvangs Alle 1
P.O. Box 2715
DK-2100 Copenhagen
Denmark

Tel: [45] 3915-1776
Fax: [45] 3929-1533
e-mail: nkh@ddre.dk

KROGAGER, Dr. E.

Danish Defence Research Establishment
Ryvangs Alle 1
P.O. Box 2715
DK-2100 Copenhagen Ø
Denmark

Tel: [45] 3915-1736
Fax: [45] 3929-1533
e-mail: ek@ddre.dk

FRANCE

BOUCHAÏB, Mr. E.

FDC
10 cours Louis Lumière
94300 Vincennes
France

Tel: [33] 1 53-66-11-16
Fax: [33] 1 53-66-11-00
e-mail: eric.bouchaib@fdc.fr

COLLOMB, Mr. F.

FDC
10 cours Louis Lumière
94300 Vincennes
France

Tel: [33] 1 53-66-11-05
Fax: [33] 1 53-66-11-00
e-mail: frederic.collomb@fdc.fr

DURLIAT, Mr. E.

MINDEF / DGA
SPART Antenne de Bourges
rocade est – Echangeur de Guerry
18021 Bourges
France

Tel: [33] 2 4827-4181
Fax: [33] 2 4827- 4902
e-mail: emmanuel.durliat@dga.defense.gouv.fr

FILOCHE, Mr. J.Y.

FDC
10 cours Louis Lumière
94300 Vincennes
France

Tel: [33] 1 53-66-11-11
Fax: [33] 1 53-66-11-00
e-mail: jean-yves.filoche@fdc.fr

ANNEX D – LIST OF PARTICIPANTS

GUYVARCH, Mr. J.P.

TDA
Route d'Ardon
45240 La Ferté Saint-Aubin
France

Tel: [33] 2 38-51-66-10
Fax: [33] 2 38-51-69-47
e-mail: jean-paul.guyvarch@tda.thalesgroup.com

JACQUET, Mr. J.F.

MINDEF/DGA
ETBS
Rocade Est Echangeur de Guerry
18021 Bourges Cedex
France

Tel: [33] 2 48-27-46-85
Fax: [33] 2 48-37-47-65
e-mail: jean-francois.jacquet@dga.defense.gouv.fr

JORAM, Capt. F.

Direction des affaires juridiques
14, Rue Saint Dominique
00455 Armées
France

Tel: [33] 1 42-19-48-49
Fax: [33] 1 42 19 72 07
e-mail: frederic.joram@sga.defense.gouv.fr

MANGIN, Mr F.

FDC
10 Cours Louis Lumière
94300 Vincennes
France

Tel: [33] 1 5366-1112
Fax: [33] 1 5366-1100
e-mail: franck.mangin@fdc.fr

MOEGLIN, Dr. J.P.

ISL
5, rue du Général Cassagnou
68301 Saint-Louis
France

Tel: [33] 3 89-69-58-68
Fax: [33] 3 89-69-50-77
e-mail: moeglin@isl.tm.fr

SURATEAU, Mr. D.

MINDEF/DGA
SPART Antenne de Bourges-rocade Est
echangeur de Guerry
18021 Bourges cedex
France

Tel: [33] 2 48-27-42-84
Fax: [33] 2 48 27 49 01
e-mail: jean.surateau@dga.defense.gouv.fr

GERMANY

GANGHOFER, Mr.

Diehl Munitionssysteme
Fischbachstrasse 16
90552 Röthenbach a.d. Pegnitz
Germany

Tel: [49] 911 957 2733
Fax: [49] 911 957 2900
e-mail: ganghofer.andreas@diehl-mun.de

HENCHE, Mr. G.

BWB
Wehrtechnische Dienststelle für Schutz- und
Sondertechnik
Oberjettenberg
83458 Schneizlreuth
Germany

Tel: [49] 8651-79-1290
Fax: [49] 8651-1600
e-mail: gerdHenche@bwb.org

REIMANN, Dr. K.D.

BWB
Sandberg 3
D-24214 Gettorf
Germany

Tel: [49] 434-618-05
Tel2: [49] 431-800-60-15
Fax: [49] 431-800-60-11
e-mail: reimanddreiget@aol.com

SPORER, Mr. M.

Diehl Munitionssysteme
Fischbachstrasse 16
90552 Röthenbach a.d. Pegnitz
Germany

Tel: [49] 911 957 2931
Fax: [49] 911 957 2210
e-mail: michael.sporer@diehl-mun.de

THIEL, Dr. K.

ICT
PO BOX 1240
D-76327 Pfinztal (Bergh.)
Germany

Tel: [49] 721-4640-375
Fax: [49] 721-4640-111
e-mail: kdt@ict.fhg.de

WILHELM, Maj. V.

Heeresamt 1/ GETRADOC
Bruhlerstrasse 300
50968 Köln
Germany

Tel: [49] 221 9371 2935
Fax: [49] 221 9371 2350
e-mail: volkerwilhem@bundeswehr.org

HUNGARY**BARTHA, LTC T.**

Head of the Engineering Office for Mechanics
MoD Technology Agency
Szilagyi Erzsebet fasor 20
Hungary

Tel: [36] 1 394-3003
Fax: [36] 1 394-3014
e-mail: tibor.bartha@hmhti.hu

SZUCS, Maj. G.

MH OHK
Budapest, Hungary
Pf. 25
1885
Hungary

Tel: [36] 30931 6431
Fax: [36] 1474-1333
e-mail: gaborszucs@yahoo.com

NETHERLANDS**FINK, Lt. M.**

Van de Burchlaan 31
2500 ES The Hague
The Netherlands

Tel: [31] 70 31 62 231
Fax: [31] 70 31 63 697
e-mail: juzakm@marstaf.navy.dnet.mindef.nl

PAULISSEN, Mr. P.

TNO-PML
P.O. Box 45
2280 AA Rijswijk
The Netherlands

Tel: [31] 15 284-3264
Tel2: [31] 6 22-41-98-61
Fax: [31] 15 284-3959
e-mail: paulissen@pml.tno.nl

ANNEX D – LIST OF PARTICIPANTS**RADEMAKER, Mr. M.**

FEL-TNO
Oude Waalsdorperweg 63
P.O. Box 96864
2509 JG The Hague
The Netherlands

Tel: [31] 70 374-0139
Fax: [31] 70 374-0642
e-mail: rademaker@fel.tno.nl

TEMPELAARS, Maj. C.

Bernard Kazerne
PO Box 3003
3800 DA Amerfoort
The Netherlands

Tel: [31] 33 466 1289
Fax: [31] 33 466 1284
e-mail: kenniscentrum.otcam@rnla.mindef.nl

VAN ANTWERPEN, Mr. M.

Department of Defence Concepts
Plein 4 Postbus 20701
2500 ES The Hague
The Netherlands

Tel: [31] 70 318-83-59
Fax: [31] 70 318 6654
e-mail: mj.v.Antwerpen@mindef.nl

VERHEIJ, Mr. Z.

TNO-PML
P.O. Box 45
2280 AA Rijswijk
The Netherlands

Tel: [31] 15 284-3446
Tel2: [31] 6 51-40-29-51
Fax: [31] 15 284-3959
e-mail: verheij@pml.tno.nl

SWEDEN**ARVIDSSON, Mr. P.**

FMV
S-11588 Stockholm
Sweden

Tel: [46] 8 782 4181
Fax: [46] 8 782 6412
e-mail: per.arvidsson@fmv.se

SUNDBERG, Col. U.

Swedish Defence Research Agency
Grindsjon Research Center
SE-147 25 Tumba
Sweden

Tel: [46] 8 5550 4064
Fax: [46] 8 5550 4149
e-mail: ulf.sundberg@foi.se

THUNMAN, Mr. L.

Swedish National Defence College
PO Box 1240
10369 Stockholm
Sweden

Tel: [46] 8 551 74 510
Fax: [46] 8 202 371
e-mail: leif.thunman@telia.com

SWITZERLAND**LOYE, Mr. D.**

ICRC
19, Avenue de la Paix
1202 Geneva
Switzerland

Tel: [41] 2 27-30-27-49
Fax: [41] 2 27-33-20-57
e-mail: dloye@icrc.org

UNITED KINGDOM**BURGESS, Mr. M.**

BAE Systems
Building 20A-1
Southernead Road
Filton
Bristol 8511 OEP
UK

Tel: [44] 7 80-171-3421
Fax: [44] 117 317 3710
e-mail: mark.burgess@baesystems.com

GORMAN, Mr. M.

UK Ministry of Defence
Counter Proliferation & Arms Control Directorate
CPAC-CB3-Room 2/33
Metropole Building
Northumberland Avenue
London WC2N 5BL
UK

Tel: [44] 20 721-80-870
Fax: [44] 20 721-186-360
e-mail: pcs3-3@netcomuk.co.uk

HOLLEY, Mr. D.

BAE Systems
Building 6-B16
RO Defence
GLASCOED NP15 1XL
UK

Tel: [44] 1291 674224
Fax: [44] 1291 674232
e-mail: dave.holley@baesystems.com

MARTINGALE, Dr. L.

DSTL
Room A004 Building 7
Porton Down
Salisbury JP4 0SQ
UK

Tel: [44] 1980-614-675
Fax: [44] 1980-613-311
e-mail: lmartingale@dstl.gov.uk

UNITED STATES**BOWMAN, Col. R.**

SOCOM
United States

e-mail: bowmanr@socom.mil

NELSON, Mr. J.

Senior International Defense Analyst
American Systems Corporation
17961 Dumfries Plaza
Dumfries 22026, VA
United States

Tel: [1] 703 441-2549 x1019
Fax: [1] 703 441-8919
e-mail: John.Nelson@2asc.com

RUTIGLIANO, Mr. J.

CMC (JAO)
2 Navy Annex
Pentagon 5C 760
Washington DC 20380-1775
United States

Tel: [1] 703 614 2793
Fax: [1] 703 695 0325
e-mail: rutiglianoja@hqmc.usmc.mil

ANNEX D – LIST OF PARTICIPANTS

SHWAERY, Mr. G.

301 Pettee House – Garrison Avenue
University of New Hampshire
DURHAM, NH 03824
United States

Tel: [1] 603 862 0520
Fax: [1] 603 862 0700
e-mail: glenn.shwaery@unh.edu

IMS

SOWA, Col. A.

IMS, LA&R Division
NATO HQ
B-1110 Brussels
Belgium

Tel: [32] 2 707-5360
Fax: [32] 2 707-9869
e-mail: lar.r&t@hq.nato.int

RTA/TSCO

Dr. J. VERMOREL

NATO HQ
Z-Building
Boulevard Leopold III
1110 Brussels
Belgium

Tel: [32] 2 707 44 20
Fax: [32] 2 707 41 03
e-mail: tsc@hq.nato.int or
j.vermorel@hq.nato.int

Mr. C. BOUMAN

NATO HQ
Z-Building
Boulevard Leopold III
1110 Brussels
Belgium

Tel: [32] 2 707 42 66
Fax: [32] 2 707 41 03
e-mail: tsc@hq.nato.int or
c.bouman@hq.nato.int

Ms. A. BEIRNAERT

NATO HQ
Z-Building
Boulevard Leopold III
1110 Brussels
Belgium

Tel: [32] 2 707 42 85
Fax: [32] 2 707 41 03
e-mail: tsc@hq.nato.int or
a.beirnaert@hq.nato.int

REPORT DOCUMENTATION PAGE			
1. Recipient's Reference	2. Originator's References	3. Further Reference	4. Security Classification of Document
	RTO-TR-SAS-040 AC/323(SAS-040)TP/34	ISBN 92-837-1122-X	UNCLASSIFIED/ UNLIMITED
5. Originator	Research and Technology Organisation North Atlantic Treaty Organisation BP 25, F-92201 Neuilly-sur-Seine Cedex, France		
6. Title	Non-Lethal Weapons and Future Peace Enforcement Operations		
7. Presented at/Sponsored by	The RTO Studies, Analysis and Simulation Panel (SAS).		
8. Author(s)/Editor(s)	Multiple		9. Date November 2004
10. Author's/Editor's Address	Multiple		11. Pages 66
12. Distribution Statement	There are no restrictions on the distribution of this document. Information about the availability of this and other RTO unclassified publications is given on the back cover.		
13. Keywords/Descriptors	Antipersonnel weapons Government policies International cooperation International law International relations LoAC (Law of Armed Conflict)	Low intensity conflict Military law Mission profiles NLW (Non-Lethal Weapons) Operational effectiveness Peacekeeping	Requirements Reviewing Scenarios Threat evaluation Weapon systems Weapons effects
14. Abstract	<p>The NATO Long Term Scientific Study (LTSS) SAS-040 has been tasked to prepare a Multinational Exercise (MNE) dedicated to the analysis of the use of non-lethal weapons in future peace enforcement operations. To achieve this aim, experts from various origins – military, lawyers, technical experts, representatives of industry, non-governmental organizations, etc. – have participated in this MNE. Three main themes have been adopted in tackling the use of NLW: Operational context, Technologies that can be envisaged, Legal and Political implications and constraints to be taken into account.</p> <p>This document presents the agreed output of the MNE. Specific chapters deal with the general aspects of the themes under consideration. A particular analysis of six concrete situations in which NLW might be used has been also realized. For each theme, conclusions and recommendations are developed in the last chapter of the document.</p>		





BP 25
F-92201 NEUILLY-SUR-SEINE CEDEX • FRANCE
Télécopie 0(1)55.61.22.99 • E-mail mailbox@rta.nato.int



DIFFUSION DES PUBLICATIONS
RTO NON CLASSIFIEES

Les publications de l'AGARD et de la RTO peuvent parfois être obtenues auprès des centres nationaux de distribution indiqués ci-dessous. Si vous souhaitez recevoir toutes les publications de la RTO, ou simplement celles qui concernent certains Panels, vous pouvez demander d'être inclus soit à titre personnel, soit au nom de votre organisation, sur la liste d'envoi.

Les publications de la RTO et de l'AGARD sont également en vente auprès des agences de vente indiquées ci-dessous.

Les demandes de documents RTO ou AGARD doivent comporter la dénomination « RTO » ou « AGARD » selon le cas, suivi du numéro de série. Des informations analogues, telles que le titre est la date de publication sont souhaitables.

Si vous souhaitez recevoir une notification électronique de la disponibilité des rapports de la RTO au fur et à mesure de leur publication, vous pouvez consulter notre site Web (www.rta.nato.int) et vous abonner à ce service.

CENTRES DE DIFFUSION NATIONAUX

ALLEMAGNE

Streitkräfteamt / Abteilung III
Fachinformationszentrum der
Bundeswehr (FIZBw)
Friedrich-Ebert-Allee 34, D-53113 Bonn

BELGIQUE

Etat-Major de la Défense
Département d'Etat-Major Stratégie
ACOS-STRAT – Coord. RTO
Quartier Reine Elisabeth
Rue d'Evère, B-1140 Bruxelles

CANADA

DSIGRD2
Bibliothécaire des ressources du savoir
R et D pour la défense Canada
Ministère de la Défense nationale
305, rue Rideau, 9^e étage
Ottawa, Ontario K1A 0K2

DANEMARK

Danish Defence Research Establishment
Ryvangs Allé 1, P.O. Box 2715
DK-2100 Copenhagen Ø

ESPAGNE

SDG TECEN / DGAM
C/ Arturo Soria 289
Madrid 28033

ETATS-UNIS

NASA Center for AeroSpace
Information (CASI)
Parkway Center, 7121 Standard Drive
Hanover, MD 21076-1320

FRANCE

O.N.E.R.A. (ISP)
29, Avenue de la Division Leclerc
BP 72, 92322 Châtillon Cedex

GRECE (Correspondant)

Defence Industry & Research
General Directorate, Research Directorate
Fakinos Base Camp, S.T.G. 1020
Holargos, Athens

HONGRIE

Department for Scientific Analysis
Institute of Military Technology
Ministry of Defence
H-1525 Budapest P O Box 26

ISLANDE

Director of Aviation
c/o Flugrad
Reykjavik

ITALIE

Centro di Documentazione
Tecnico-Scientifica della Difesa
Via XX Settembre 123
00187 Roma

LUXEMBOURG

Voir Belgique

NORVEGE

Norwegian Defence Research Establishment
Attn: Biblioteket
P.O. Box 25, NO-2007 Kjeller

PAYS-BAS

Royal Netherlands Military
Academy Library
P.O. Box 90.002
4800 PA Breda

POLOGNE

Armament Policy Department
218 Niepodleglosci Av.
00-911 Warsaw

PORTUGAL

Estado Maior da Força Aérea
SDFA – Centro de Documentação
Alfragide
P-2720 Amadora

REPUBLIQUE TCHEQUE

DIC Czech Republic – NATO RTO
LOM PRAHA s. p.
o.z. VTÚL a PVO
Mladoboleslavská 944, PO BOX 16
197 21 Praha 97

ROYAUME-UNI

Dstl Knowledge Services
Information Centre, Building 247
Dstl Porton Down
Salisbury
Wiltshire SP4 0JQ

TURQUIE

Milli Savunma Bakanlığı (MSB)
ARGE ve Teknoloji Dairesi Başkanlığı
06650 Bakanlıklar – Ankara

AGENCES DE VENTE

NASA Center for AeroSpace Information (CASI)

Parkway Center, 7121 Standard Drive
Hanover, MD 21076-1320
ETATS-UNIS

The British Library Document Supply Centre

Boston Spa, Wetherby
West Yorkshire LS23 7BQ
ROYAUME-UNI

Canada Institute for Scientific and Technical Information (CISTI)

National Research Council
Acquisitions, Montreal Road, Building M-55
Ottawa K1A 0S2, CANADA

Les demandes de documents RTO ou AGARD doivent comporter la dénomination « RTO » ou « AGARD » selon le cas, suivie du numéro de série (par exemple AGARD-AG-315). Des informations analogues, telles que le titre et la date de publication sont souhaitables. Des références bibliographiques complètes ainsi que des résumés des publications RTO et AGARD figurent dans les journaux suivants :

Scientific and Technical Aerospace Reports (STAR)

STAR peut être consulté en ligne au localisateur de ressources uniformes (URL) suivant:

<http://www.sti.nasa.gov/Pubs/star/Star.html>

STAR est édité par CASI dans le cadre du programme NASA d'information scientifique et technique (STI)
STI Program Office, MS 157A
NASA Langley Research Center
Hampton, Virginia 23681-0001
ETATS-UNIS

Government Reports Announcements & Index (GRA&I)

publié par le National Technical Information Service

Springfield
Virginia 2216
ETATS-UNIS

(accessible également en mode interactif dans la base de données bibliographiques en ligne du NTIS, et sur CD-ROM)



BP 25
F-92201 NEUILLY-SUR-SEINE CEDEX • FRANCE
Télécopie 0(1)55.61.22.99 • E-mail mailbox@rta.nato.int



DISTRIBUTION OF UNCLASSIFIED RTO PUBLICATIONS

AGARD & RTO publications are sometimes available from the National Distribution Centres listed below. If you wish to receive all RTO reports, or just those relating to one or more specific RTO Panels, they may be willing to include you (or your Organisation) in their distribution.

RTO and AGARD reports may also be purchased from the Sales Agencies listed below.

Requests for RTO or AGARD documents should include the word 'RTO' or 'AGARD', as appropriate, followed by the serial number. Collateral information such as title and publication date is desirable.

If you wish to receive electronic notification of RTO reports as they are published, please visit our website (www.rta.nato.int) from where you can register for this service.

NATIONAL DISTRIBUTION CENTRES

BELGIUM

Etat-Major de la Défense
Département d'Etat-Major Stratégie
ACOS-STRAT – Coord. RTO
Quartier Reine Elisabeth
Rue d'Evère
B-1140 Bruxelles

CANADA

DRDKIM2
Knowledge Resources Librarian
Defence R&D Canada
Department of National Defence
305 Rideau Street
9th Floor
Ottawa, Ontario K1A 0K2

CZECH REPUBLIC

DIC Czech Republic – NATO RTO
LOM PRAHA s. p.
o.z. VTÚL a PVO
Mladoboleslavská 944, PO BOX 16
197 21 Praha 97

DENMARK

Danish Defence Research
Establishment
Ryvangs Allé 1
P.O. Box 2715
DK-2100 Copenhagen Ø

FRANCE

O.N.E.R.A. (ISP)
29, Avenue de la Division Leclerc
BP 72
92322 Châtillon Cedex

GERMANY

Streitkräfteamt / Abteilung III
Fachinformationszentrum der
Bundeswehr (FIZBW)
Friedrich-Ebert-Allee 34
D-53113 Bonn

GREECE (Point of Contact)

Defence Industry & Research
General Directorate, Research Directorate
Fakinos Base Camp, S.T.G. 1020
Holargos, Athens

HUNGARY

Department for Scientific Analysis
Institute of Military Technology
Ministry of Defence
H-1525 Budapest P O Box 26

ICELAND

Director of Aviation
c/o Flugrad, Reykjavik

ITALY

Centro di Documentazione
Tecnico-Scientifica della Difesa
Via XX Settembre 123
00187 Roma

LUXEMBOURG

See Belgium

NETHERLANDS

Royal Netherlands Military
Academy Library
P.O. Box 90.002
4800 PA Breda

NORWAY

Norwegian Defence Research
Establishment
Attn: Biblioteket
P.O. Box 25, NO-2007 Kjeller

POLAND

Armament Policy Department
218 Niepodleglosci Av.
00-911 Warsaw

PORTUGAL

Estado Maior da Força Aérea
SDFA – Centro de Documentação
Alfragide, P-2720 Amadora

SPAIN

SDG TECEN / DGAM
C/ Arturo Soria 289
Madrid 28033

TURKEY

Milli Savunma Bakanlığı (MSB)
ARGE ve Teknoloji Dairesi Başkanlığı
06650 Bakanliklar – Ankara

UNITED KINGDOM

Dstl Knowledge Services
Information Centre, Building 247
Dstl Porton Down
Salisbury, Wiltshire SP4 0JQ

UNITED STATES

NASA Center for AeroSpace
Information (CASI)
Parkway Center, 7121 Standard Drive
Hanover, MD 21076-1320

SALES AGENCIES

NASA Center for AeroSpace Information (CASI)

Parkway Center
7121 Standard Drive
Hanover, MD 21076-1320
UNITED STATES

The British Library Document Supply Centre

Boston Spa, Wetherby
West Yorkshire LS23 7BQ
UNITED KINGDOM

Canada Institute for Scientific and Technical Information (CISTI)

National Research Council
Acquisitions
Montreal Road, Building M-55
Ottawa K1A 0S2, CANADA

Requests for RTO or AGARD documents should include the word 'RTO' or 'AGARD', as appropriate, followed by the serial number (for example AGARD-AG-315). Collateral information such as title and publication date is desirable. Full bibliographical references and abstracts of RTO and AGARD publications are given in the following journals:

Scientific and Technical Aerospace Reports (STAR)

STAR is available on-line at the following uniform resource locator:

<http://www.sti.nasa.gov/Pubs/star/Star.html>

STAR is published by CASI for the NASA Scientific and Technical Information (STI) Program
STI Program Office, MS 157A
NASA Langley Research Center
Hampton, Virginia 23681-0001
UNITED STATES

Government Reports Announcements & Index (GRA&I)

published by the National Technical Information Service
Springfield
Virginia 2216
UNITED STATES
(also available online in the NTIS Bibliographic Database or on CD-ROM)