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Counter biological and chemical terrorism – WP8000: Conclusions and recommendations

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English summary

This report constitutes an unclassified summary of the main results and conclusions of the European Defence Agency project "Counter Biological and Chemical Terrorism", EDA-0156-GEM3-ERG. The overall objective has been is to analyse the threats, possible consequences, emergency preparedness and response measures in the case of terrorist actions using biological or chemical agents, both with respect to procedures, equipment, and training. Six nations have participated in this project; Belgium, France, Italy, Norway, Sweden and Spain. Norway has been the lead nation.

The effectiveness and possible consequences of biological and chemical attacks depend on the properties of the threat agent and the method of dispersion. Lists of important biological and chemical threat compounds and their properties were established and used to develop and select six scenarios. These were discussed and compared in order to analyse emergency response differences and similarities between the nations and identify shortcomings. Dispersion models and hazard prediction and assessment tools can be used before, during and after an event for emergency preparedness planning, response and forensic purposes. The project has established an overview of available models and models used by the participating organisations. The group has compared protective equipment, decontamination systems, detection and field identification equipment and medical countermeasures used in the six nations. The project made a comparison of the governing principles of crisis and consequence management, and the strategic, regional and operational emergency preparedness and response to biological and chemical incidents.

In order to further improve the preparedness to chemical and biological related terrorism the project team suggests the following:

- To establish a uniform emergency telephone number in Europe
- To arrange recurrent exercises involving the European countries in order to improve the management of many exposed individuals and to identify other capability gaps
- To maintain and improve the multilateral epidemiological networks
- To maintain and further develop the networks of designated chemical and biological analytical laboratories for analysis of chemical warfare agents, toxic industrial chemicals and infectious agents
- To jointly practise large-scale decontamination, for example at public transport nodes or other public centres. The confident verification of the absence of a toxic substance or an infectious agent is of utmost importance
- To improve the accessibility to, and capability of, decontamination units and medical resources
- To further compare and assess European capability gaps and preparedness to CB(RN) terrorism
- To establish well validated dispersion models adapted to the variety of climate and terrain across Europe
- To continue to monitor the natural biological background in air

Sammendrag

Denne rapporten er en ugradert oppsummering av de viktigste resultatene og konklusjonene i prosjektet "Counter Biological and Chemical Terrorism" under European Defence Agency, EDA-0156-GEM3-ERG. Den overordnede målsetningen har værtr å analysere trusler, mulige konsekvenser, kriseberedskap og tiltak ved terrorangrep med biologiske eller kjemiske trusselstoffer, både med hensyn på prosedyrer, utstyr og trening. Seks land har deltatt i prosjektet; Belgia, Frankrike, Italia, Norge, Sverige og Spania. Norge har ledet prosjektet.

Effektiviteten og mulige konsekvenser av biologiske og kjemiske angrep avhenger av egenskapene til trusselstoffet og spredningsmetoden. Lister over viktige biologiske og kjemiske trusselstoffer og deres egenskaper ble etablert og brukt til å utvikle og velge seks scenarioer. Disse ble diskutert og sammenlignet for å analysere forskjeller og likheter i kriseberedskap i de landene og identifisere mangler. Spredningsmodeller og fareprediksjonsverktøy kan brukes før, under og etter en hendelse for beredskapsplanlegging, respons eller etterforskning. Prosjektet har laget en oversikt over tilgjengelige modeller og modeller brukt av deltakerne. Gruppen har sammenliknet hvilket beskyttelsesutstyr, rensesystemer, deteksjons- og feltidentifikasjonsutstyr og medisinske motmidler som brukes i de seks landene. Prosjektet har sammenlignet overordnede prinsipper for krisehåndtering, og strategisk, regional og lokal krisehåndtering og respons ved biologiske og kjemiske hendelser.

For å forbedre beredskap ved kjemisk og biologisk terrorisme foreslår prosjektgruppen følgende:

- Å etablere ett enhetlig krisetelefonnummer i Europa
- Å arrangere periodiske øvelser for europeiske land for å forbedre krisehåndtering der mange personer eksponeres og identifisere andre kapabilitetsmangler
- Å opprettholde og forbedre multilateral epidemiologiske nettverk
- Å opprettholde og videreutvikle nettverkene av kjemiske og biologiske analyselaboratorier for analyse av kjemiske stridsmidler, giftige industrikjemikalier og infeksiøse agens
- Å arrangere felles storskala renseøvelser, for eksempel ved transportknutepunkt eller offentlige sentra. Sikker verifikasjon for at et giftig stoff eller en infeksiøs agens ikke er til stede er avgjørende
- Å forbedre tilgjengeligheten og kapabiliteter for rens og medisinske ressurser
- Å videre sammenlikne og analysere europeiske kapabilitetsmangler og beredskap ved CB(RN) terrorisme
- Å etablere godt validerte spredningsmodeller tilpasset det varierende klima og topografi man finner i Europa
- Å fortsette registrering og overvåking av den naturlige biologiske bakgrunnen i luft

Contents

1 Introduction

There is an increased concern about the threat for possible terrorist activities using biological and chemical agents. The civilian population as well as military personnel or installations can be targeted. Hence, this challenge is both of military and civilian concern. The threat of possible terrorist activities using biological and chemical agents is complex and needs to be addressed on a broad basis. In 2006 six nations launched a cooperative project entitled "Counter Biological and Chemical Terrorism". The overall objective of this project is to analyse the threats, possible consequences, emergency preparedness and response measures in the case of possible terrorist actions using biological or chemical agents. The sharing of information, discussion and analysis of this threat in an international group will increase the knowledge and awareness of all Contributing Members. This report gives an unclassified summary of the results and main conclusions of this project.

Biological and chemical terrorism is not necessarily solely a defence-oriented problem and responsibility. On the contrary, many ministries and organisations share the responsibility to deal with the consequences of such attacks. However, for many years, defence forces and defence research institutions have been focussing a significant amount of resources to protect its military troops and installations against chemical and biological warfare agents. This encompasses threat analysis, detection and identification, physical protection, collective protection, medical protection, treatment and countermeasures, dispersion modelling and prediction of consequences. Hence, the experience and expertise of defence organisations are often drawn upon in preparing and planning to counter incidents with chemical and biological agents, and in consequence management and response.

Six nations contribute in this project; Belgium, France, Italy, Norway, Sweden and Spain. Norway is the lead nation. The participating organisations are:

- Belgian Defence, Division Santé, sous-section Epidémiologie et Biostatistiques
- French Ministry of Defence - Délégation Générale pour l'Armement (DGA) - Recherche Défense – Radiologique, Biologique et Chimique le Bouchet (CEB)
- Italian Ministry of Defence (SEGREDIFESA / 5TH Department R&T)
- Norwegian Defence Research Establishment (FFI)
- Spanish Ministry of Defence, DGAM-SGTECEN
- Swedish Defence Research Agency (FOI)

The project work is organised in six Work Packages (WP) listed in Table 1.1.

Table 1.1 The work packages of the project EDA-0156-GEM3-ERG "Counter Biological and Chemical Terrorism".

WP	Title
WP 1000	Assessment of the threat – Listing of possible B and C threat agents
WP 2000	Possible military and civilian scenarios
WP 3000	Exchange of information and comparison of different models used by nations to predict the effects of biological and chemical events
WP 4000	Monitoring microbiological baselines within the environment
WP 5000	Reflection concerning appropriate equipment
WP 6000	Exchange information concerning the organisation in Europe to treat the problem
WP 7000	Contact with other co-operate projects, such as TA 113.034 "NBC-modelling and simulation" and JP 13.14 "Identification of B agents"
WP 8000	Conclusions and recommendations for possible actions to counter B and C terrorism

The project was initiated 11 January 2006, and the duration is three years with a completion date 11 January 2009. The Western European Armaments Organisation (WEAO) endorsed the Technical Arrangement No 113.046 to ERG Arrangement No 1 under the Europa MOU on 11 January 2006. EDA accepted this project as an Ad Hoc Category B R&T project on 23 January 2007 (project number EDA-0156-GEM3-ERG). The project has been funded by the respective Ministries of Defence.

This report presents the results of WP 8000: "Conclusions and recommendations for possible actions to counter biological and chemical terrorism". The aims are:

- To summarise the results of the work in all work packages of this cooperative project
- To draw conclusions and present recommendations on possible measures to improve emergency response preparedness against biological and chemical incidents and mitigate their consequences

Chapters 2 to 8 give an unclassified summary of the work and main conclusions in each work package of the project. Chapter 9 gives the main conclusions and recommendations. A separate report has been published for each work package (see references [1] - [6]). Some of these reports contain information that is exempt from public disclosure or classified due to security concerns. The present report constitutes an unclassified summary of the project work.

It should be noted that the opinions and comments expressed in this report represent the views and perceptions of the authors and not necessarily national views.

2 Biological and chemical threat agents

WP 1000 is entitled "Assessment of the threat – Listing of possible B and C threat agents". The effectiveness and possible consequences of biological and chemical attacks depend on the properties of the threat agent and the method of dispersion. The project team has established lists of selected chemical and biological threat agents and their properties based on open source information. The purpose of the lists is to serve as a basis to identify possible threat agents and establish scenarios for further assessment.

The number of potential chemical and biological threat agents is vast, and it would be an impossible task to include all relevant agents. The emphasis has therefore been limited to agents that pose a direct threat to humans through their effect on the health. The lists comprise important threat compounds selected based on criteria such as availability, toxicity, infectivity, ease of dissemination, stability etc. Numerous available lists from the open literature were assessed and used as a starting point. We refer to the full report for details.[1]

Biological threat agents comprise micro-organisms, i.e. bacteria, rickettsia and viruses, and toxins, which may cause disease or poisoning in humans, animals or plants. The final list comprises 75 biological threat agents in total which pose a threat to humans. The list includes information on name, type (bacteria, virus, or toxin), type of infection, transmissibility from man to man, route of exposure, environmental reservoir, stability, incubation time, lethal dose, infection dose, lethality, and availability of medical treatment.

Numerous chemicals may pose a threat to humans, animals or to the environment due to their toxicity, flammability or reactivity, or a combination of these properties. Flammable and reactive chemicals were not considered in this project. The lists are limited to chemicals that pose a threat to humans primarily due to their toxicity. The final selection comprises 68 toxic chemicals, which are divided in three parts; chemical warfare agents, toxic industrial chemicals, and pesticides. The lists include information on name, Chemical Abstract Service number (CAS-no), molecular weight, boiling point, vapour pressure, lethal dose, and lethal concentration. For the chemical warfare agents precursor chemicals, i.e. starting materials for synthesis, are also included. The lists of toxic industrial chemicals also include the toxicity level “immediately dangerous to life and health” (IDLH).

3 Possible military and civilian scenarios

WP 2000 is entitled “Possible military and civilian scenarios”. For details we refer to the WP report [2]. The overall objective is to contribute to improved protection and handling of possible biological and chemical asymmetric attacks involving both military and civilian targets. The objective is achieved by analysing technical aspects of biological or chemical threat compounds, possible consequences, emergency preparedness, and response measures of selected scenarios, both with respect to procedures, equipment, and training. Identifying and analysing representative scenarios is a valuable tool for emergency planning and training, both on an operational and on a decision-making level. Within an operational context it provides valuable information to identify appropriate protection levels and recommendations regarding organisation, procedures, and equipment needs, and possible shortcomings.

The participating countries represent various parts of Europe, and different countries may have different concerns regarding the biological and chemical threat, as well as different patterns of infectious diseases. To address this issue each participating country contributed two to three proposed scenarios of special interest and challenge to their national emergency preparedness. The scenarios focused on intentional dissemination of biological or chemical agents in the civilian society or in military peace-keeping international missions. Military support to civilian crisis management was also considered. **Six scenarios** were selected for further assessment, comparison and discussion.

The details of some of these scenarios are classified, thus all details are not given here. Dispersion modelling and the consequence assessment for one of the scenarios, indoor dispersion of the highly toxic nerve agent sarin, has been published in the open literature.[7] The methodology and an overview of scenarios were presented at the European Survivability Workshop in 2008.[8]

It should be noted that intentions and capabilities of possible actors have not been evaluated, and probabilities of incidents have not been assessed in this project. This particular set of scenarios was selected as examples to illustrate various key challenges for emergency preparedness and response. Each scenario was described in a uniform template.

The scenarios fall into two main categories; chemical and biological attacks. The main distinction between the anticipated effects of chemical and biological scenarios, respectively, is the timeline. In general, chemical incidents lead to acute intoxication of exposed persons and require immediate response in order to save lives and mitigate the consequences. Most symptoms upon exposure to infectious levels of biological agents develop and manifest themselves after days and sometimes weeks. Hence, in the case of covert attacks using biological agents, the attack is most likely discovered by the health services based on outbreak of disease several days or weeks after the real incident.

The project team assessed the anticipated consequences of each of the six selected scenarios. Each participating organisation then assessed the anticipated outcome and the countermeasures and systems that would be used after a terrorist attack with intentionally disseminated biological or chemical agents in his/her own country. The results were then discussed and compared in order to analyse differences and similarities between the nations.

Responsibility and organisational matters are to a large extent similar in the six nations represented in the working group. There are though smaller differences in structures and organisations. The Spanish Guardia Civil lacks for instance corresponding organisations in the Nordic countries. However, in the discussions the organisational differences were not found to have any critical influence on the counteracting ability.

In general, there are three levels of responsibility. In the acute phase, a local team leader (police, fire brigade etc.) is responsible for the countermeasures to the incident (in the scenario at a military camp, the military commander is responsible). For a larger incident with many exposed individuals the national authorities and ministries are in charge and responsible. For instance, the national authority for disease control and prevention and the Ministry of Health have the responsibility after intentional dissemination of a contagious agent. There are, however, many different authorities at various levels (local, regional, national) involved in the operative work and crisis management. The response is on a governmental level if the incident involves many authorities and several countries.

The comparison shows that different emergency telephone numbers exist. Moreover, some countries have different numbers with respect to the type of incident. There is an ongoing discussion in many European countries concerning establishing a uniform number. Experience, from for instance Sweden, shows that a uniform emergency number is a benefit for a rapid and relevant response in an acute situation. Hence, the project team recommends one emergency number within each country and a uniform number across Europe.

In several of the scenarios the attacked nation will most likely need support of medical resources from other European countries. This support may be a request to send patients to intensive care units in neighbouring countries, treatment of patients exposed to hazardous toxic agents or pathogens causing serious infectious diseases. It is concluded that a terrorist attack leading to many exposed individuals will not be possible to handle by one single nation without support from other nations. It is suggested that recurrent exercises involving the European countries are arranged. The exercises should include education as well as critical analysis of the shortcomings on the operational level.

In order to limit the epidemic potential and to achieve a rapid and efficient treatment after a biological attack with a large number of exposed individuals, it is necessary to get in touch with potentially infected people as soon as possible. This requires well-trained and active multilateral networks.

For some infectious agents there are organism-related networks for surveillance, such as for *Salmonella* infections. Information on national outbreaks is frequently updated. These networks are available for medical specialists and authorities for control and prevention of infectious diseases. In an acute situation, information on the epidemiological situation is available and should be of help for proper assessment of the acute situation. The group recommends that epidemiological networks are maintained and improved.

The situation is different concerning identification of toxic compounds. The capacity for analysis of chemical warfare agents is found in just a few designated laboratories. Analysis of toxic industrial chemicals is available at more laboratories, but still it is limited. After an attack with a chemical warfare agent or toxic industrial chemical the proper verification will probably require that samples are simultaneously analysed at two or more laboratories in different countries. Well-working networks between laboratories exist within the Organisation for the Prohibition of Chemical Weapons (OPCW) and the North Atlantic Treaty Organisation (NATO). The capacity for analysis of toxic industrial chemicals has been improved mainly as a result of the concern for chemical terrorism. The group recommends that laboratory networks for analysis and identification of all types of chemical and biological threat agents are maintained and further developed.

Decontamination of a large public facility is expensive and tricky. An absolute request before reopening the facility will be verification of absence of threat agents or at least that the level of contamination does not exceed the background level. Non-spore forming bacteria and viruses are normally less stable organisms and are usually of no concern from a decontamination point of view. There is long experience of effective methods for decontamination of chemical warfare agents, and the concept is useful also for toxic industrial chemicals. Decontamination is, however, more complex to perform in non-military situations and environments. The challenge is not the decontamination per se, but merely to convince the public that the decontamination has been successful. Special attention must in a situation like this be paid to the forensic routines. For this purpose it is necessary to verify the absence of toxic material and to supply correct and confident information. The group recommends European cooperation and joint exercises to test large-scale decontamination, and subsequent verification of absence of threat agents.

Another type of challenge is the situation after a terrorist incident involving biological or chemical agents against a military camp in a peace-keeping operation. The camp normally has relevant protective equipment, but very few hospital beds. According to the operational guidelines, military personnel are never transported to a local hospital, but may be treated at other military field hospitals. The field hospital capacity, however, is not adjusted to a very fast progressing course of events with mass causalities. Such a situation requires a high capacity for transport and a sufficient number of beds for intensive care. This particular scenario reflects that an efficient handling of mass casualty situation in a military camp requires a proper assessment of local conditions based on adequate intelligence and international exchange of information.

In the assessments of the scenarios no detailed comparison concerning different strategies of physical protection has been performed. This issue was further discussed within the WP 5000: "Reflection concerning appropriate equipment".[5] The exchange of information on the national organisations of the civilian chemical and biological emergency preparedness and crisis management in the participating countries were addressed in WP 6000.[6]

4 Dispersion models and hazard prediction tools

WP 3000 is entitled "Exchange of information and comparison of different models used by nations to predict the effects of biological and chemical events". The objectives of this work package were to establish a list of available models, collect information on these models and summarise it in a standardised form, and compare models used by some of the participating countries for a scenario defined in WP 2000.

For details we refer to the WP 3000 report.[3] The report contains a list of more than 130 available models and an overview of the models used by the participating organisations in this project. The number of models is continuously evolving, and most of the models are regularly updated and upgraded. Consequently, the present work can never be comprehensive and include all models.

Each model is designed for specific purposes. It is of crucial importance that the user is aware of the limitations, not only related to the input, but also to the mathematical model itself. Models are used for hazard prediction, risk analysis, operational decision support, virtual prototyping, weather forecasting, and numerous other purposes. In addition, they also range from simple, user-friendly models to complex models requiring expert users and support staff. No model is suitable for all purposes. Conversely, only selected models are appropriate for supporting specific analyses.

Before you choose a model, you have to define your needs and requirements. Dependent on the moment of use for a particular event, the appropriate model could vary. Possible moments of use for the model:

a. Pre event (threat and consequence analysis, identification of high-risk areas)

- Planning
- Training
- Prevention

For example the modelling and simulation of a particular place may be used in order to optimize the positioning of detectors.

b. During the event

- Evaluation of the agent dispersion
- Defining the "at risk area" and the population at risk
- Optimisation of resources positioning and allocation
- Consequence assessment

c. Post event

- Backtracking and forensic purposes (finding the origin of the contamination, release point)
- Epidemiological studies

In pre- and post-event conditions, accurate predictions are needed and time is not a constraint, so you will prefer a robust model with fine resolution even if it needs huge computational resources and people with high level of competence and experience. In contrary, in real-time conditions, you will prefer user-friendly models with a short response time even at cost of a lower resolution.

Dispersion calculation results are approximations to the real world. Dispersion modelling experts must understand the limitations of the dispersion modelling results, and higher level decision makers must be aware of these limitations. Evacuation of large areas involving many people and possibly including critical installations has large consequences for the civil society, both psychologically and economically. In case of an attack against military installations, restriction of movement and other measures may have a great impact on the operational ability of military units. Such interventions should therefore be based on the best evidence possible. The role of models is to provide tools to the analyst, who uses the output from the models to support decision-making. The analyst will incorporate risk assessments, sensitivity analyses, and trade-off analyses to account for uncertainty and to provide the most reasonable response to decision makers and first responders.

When using these models, people must be aware of the limitations and the assumptions made by the developers and for what type of events they were intended and validated. The most common limitations of the models are:

- Need of accurate meteorological inputs, at least wind speed and direction
- Effects of topography: buildings and topographic details can have a large impact on the dispersion. The basic Gaussian dispersion equation is not intended to handle terrain regimes such as valleys, forests, shorelines, rough sea or mountains
- Most dispersion models are very generic in that the pollutant is assumed to be passively transported by the wind (buoyancy effects, instability of the agent, chemical transformation or degradation are not taken into account)
- Need of a good evaluation of the source: point, line or volume release, single or continuous release, etc. In the early phase of an event, you will probably not have all the data, thus assumptions must be made. For realistic scenarios it is virtually impossible to provide a complete description of all the parameters that enter into the model
- Some models need an internet connection to be fully effective. This may become a limitation in crisis condition
- The majority of the models also assume constant meteorological conditions over long distances, idealized plume geometry, uniform flat terrain and complete conservation of mass of the agent. Such ideal conditions rarely occur

Unfortunately, many users are unaware of those assumptions and constraints and mistakenly believe that the precision achievable with computers equates to accuracy. It has also to be noted that very few models have been validated against real spills under operational conditions.

Validation of a model is very costly. It requires systematic use of ‘fully computational models’ with long runs on big computing systems, in combination with laboratory and field experiments. In most validating experiments, the models generally overestimate downwind concentration of the agent. For security reasons, over-prediction is preferable to under-prediction, but it also means that you will deploy more resources than necessary for the counter-measures. Further investigations are needed to scientifically validate the models predictions in real situations.

One of the conclusions is that there are numerous dispersion models, but there is a lack of impact and casualties prediction models. Modelling of biological incidents or attacks is also very limited with the models currently available.

The group compared results for one of the scenarios analysed in WP 2000. This scenario involved release and dispersion of massive amounts of the toxic industrial chemical chlorine. After some discussion, especially based on results for the chlorine scenario, the group concluded that in general the available models have strong limitations for use in real time for acute incidents or attacks (evolving in minutes). In this particular case, chlorine will reach the camp long before the modeller has touched his computer. However, models remain a good and necessary tool for planning, prevention, training and real-time analysis in non-acute conditions.

It would be an advantage to establish well validated dispersion models adapted to the variety of climate and terrain across Europe. Models should be applicable to both civilian and military scenarios to estimate the exposed population in case of CBRN-incidents and include casualties-impact prediction models in order to help the commanders and the government to take adapted counter-measures for each type of event.

5 Monitoring microbiological baselines

WP 4000 is entitled "Monitoring microbiological baselines within the environment". For details we refer to the report.[4] The aerosol route is a major risk with regards to intentional release of pathogenic biological agents. Several biological warfare and threat agents listed by NATO and Centres for Disease Control and Prevention (CDC) may be deliberately dispersed in an easy way, while others require professional knowledge.

Various bacterial pathogens are commonly found in outdoor air, and several of these may pose a risk to human health, exemplified by the bacterial species *Escherichia*, *Legionella*, *Neisseria*, *Francisella*, *Burkholderia*, *Clostridium*, and *Brucella*. This demonstrates that a wide variety of airborne micro-organisms exist, and that analysis of the bacterial diversity in air is needed.

The aerosol risk should be addressed for several reasons:

- The infectious doses are usually low to very low (thus needing limited quantities of the biological agent)
- People may be unaware of dispersion (dispersed without explosion, incubation time, no immediate effect)
- A large number of targeted people can be exposed and infected (more than through the water or food supply chain)

In the case of biological detection, technologies and systems must raise an alarm only in the case of aggressive bio-aerosols and not raise "false alarms" because of the presence of the natural biological background. The latter may contain species that are biologically close to biological warfare agents, but that are non-pathogenic and occurring naturally, exemplified by *Bacillus* spp. Such species may lure a detection system lacking specificity.

The main problem with the airborne aerosol background is that it is highly variable. Its composition may vary either in quantity (total concentration of micro-organisms per litre of air) and quality (occurrence of different microbial species). Fluctuation may be very rapid, within seconds. Besides, the background concentration may be very different according to the location (urban area, countryside etc.). Such fluctuations are important for "generic" detection systems based on the quantitative biological status of the atmosphere.

Owing to the great variability, it seems impossible to model and predict background fluctuations. However, in order to set up biological defence systems (especially bio-detectors) that are able to operate in various possible background conditions, it is important to know the range of possible concentrations and the fluctuations with time.

The work package 4000 report summarises studies on the naturally occurring biological aerosols, hereafter named "the background". The data collected by DGA CEB, about 40 measurement cycles, provide some typical figures of the concentrations and also exemplify the fluctuations. These findings are consistent with previously published studies. The data is helpful to specify characteristics and also to evaluate systems.

It should be noted that biological background studies cannot be comprehensive. In order to have a global view of its diversity, long lasting studies should be carried out, at least one year to cover seasonal variations. In addition, to cover a representative diversity, the background would have to be studied in different places; urban, rural and worldwide.

Special attention should be paid to the way background measurements are obtained. The collection and analysis technologies as well as the units used to express the results may not be comparable from various sources.

The isolated knowledge of the background itself is useful, but not sufficient. The point is to evaluate its influence on biological defence systems, especially bio-detectors. Parallel studies of false alarms and background fluctuations may help to fine-tune the bio-detectors. Continued efforts to monitor the natural biological background in air is recommended and encouraged.

6 Protective equipment

The title of WP 5000 is "Reflection concerning appropriate equipment". The aim of WP 5000 is to collect and present information from all participating countries about available protective equipment against chemical and biological threat agents (in the period 2006-2008), including new equipment. Further, the objective is to evaluate the available protective equipment in the participating nations, in three categories; detection, protection and decontamination, and identify possible gaps between the available equipment and the threats arising from possible terrorist actions using biological or chemical agents. The work was organised in five Work Elements (WE), focusing on various types of protective equipment:

- WE 5100 Individual Protective Equipment
- WE 5200 Collective Protection
- WE 5300 Detection and Identification
- WE 5400 Medical protection
- WE 5500 Decontamination

Individual protective equipment

All six nations use various products as their basic equipment for respiratory protection (respirators and canisters) and protective clothing (suits, gloves and boots). All have impermeable suits and lighter and more comfortable suits (permeable and semi-permeable), used in accordance with national procedures. The type of equipment and protective levels is substantially homogeneous between nations.

Equipment and facilities for collective protection

All six nations have collective protection systems for military personnel. Italy, Sweden and Norway also have shelters for the civilian population. Several nations have specific reconnaissance vehicles for activities in potentially chemical and biological contaminated areas. These vehicles offer collective protection for the personnel, but their primary purpose is sampling, detection and identification.

Equipment for C and B detection and field identification

Sweden and Spain have the largest number of different instrumental equipment for detection and field identification of chemical and biological agents. The nations in general use different devices from a range of suppliers, but all have CAM (Chemical Agent Monitor) for detection of chemical warfare agents. Belgium and Norway do not have any device dedicated to biological field detection. The best equipped nation seems to be Sweden.

Medical protection

All participating nations have substantially homogeneous equipment for prophylaxis and treatment of nerve agent poisoning. This includes prophylactic drugs (pyridostigmine) and autoinjectors with atropine and an oxime. Sweden uses the oxime HI-6 instead of the more common obidoxime.

This group did not consider vaccines as part of this work for the following reasons:

- There are too many agents and existing or potential vaccines
- There is no agreement at the international level for the need of some vaccines

This group did not consider antibiotic stockpiles. The subject of medical countermeasures, in particular vaccines and antibiotics, are dealt with by the European Commission project Bio3R.

Decontamination
All participating nations use devices based on high pressure water generation and various active chemicals against specific chemical and biological threat agents. The best equipped nation seems to be Sweden.

Conclusions
The report of WP 5000 contains lists of the biological and chemical detection, protection and decontamination equipment used in the participating countries.[5] The lists include information on the type of equipment, producer, the user, technical information etc. There are quite homogeneous capabilities, but sometimes based on different systems.

Rapid detection for biological agents is still not adequate, and the concerned principal tools are based on fluorescence or flame spectrometry. Identification of biological agents is based on molecular techniques, immunology and other techniques.

Based on the information received, there is not enough protective clothing and masks to protect civil and military people in a massive biological or chemical terrorist attack.

New technologies in the fields of nanotechnologies, sensors, new materials, robotics, networks, computerisation, modelling and simulation should improve the capabilities in biological and chemical defence and, in particular, the capability to mitigate the consequences of terrorist attacks. The group supports and encourages nations to sustain further research in these fields. Networking of sensors and detectors will in the future reduce the false alarm rate, and also enable alarms to be transmitted to larger areas, and thereby give the possibility for faster response.

A network between nations in order to monitor and control the evolution of biological and chemical terrorist attacks could be another aspect to be developed.

7 Emergency preparedness and response

WP 6000 is entitled “Exchange information concerning the organisation in Europe to treat the problem“. The aim is to exchange information on national emergency preparedness and response to biological and chemical incidents in the six participating countries. The WP report describes the governing principles of crisis and consequence management in these countries, and the strategic, regional and operational emergency preparedness and response to biological and chemical incidents, both accidents and terrorist actions.[6]

There are large differences between the participating countries when it comes to geography, size and density of the population. There are however some interesting variations worthy of further consideration and discussion. However, the differences observed do not seem to impair effectiveness of emergency response. In some countries, military structures like the Italian Carabinieri, Spanish Guardia Civil and the French Gendarmerie, have operational tasks. This is not the case in Sweden, Norway and Belgium. Some countries have one and the same emergency telephone number (112), irrespective of the event. Implementation of this unified number across Europe should be considered.

Some countries have already experienced terrorist attacks, or have been exposed to severe chemical or biological disasters or problems, for instance the Seveso accident in Italy, and old chemical weapons from the first and second world wars. The perceived level of chemical and biological threat varies among the countries.

Nevertheless, the results of this study show a remarkable similarity in the response patterns and emergency preparedness methods used by each country. Crisis and consequence management in case of biological and chemical incidents build on existing structures and resources. We see that the response pattern depends on the scale of the event. Operationally, small-scale incidents, both intentional and unintentional, will be managed at the local level by the local first responders and support services. For larger incidents regional and national resources will be called upon. However, in the particular case of terrorist attacks, irrespective of the scale of impact, national authorities will always be involved to some extent, at least for forensic work and communication. In all participating countries, civilian authorities will be in charge of crisis and consequence management in terrorist attacks on national soil. Military CBRN experts and units could be called upon if needed.

The countries are probably more prepared to handle a chemical attack than a biological attack due to the experience and countermeasures for industrial chemicals accidents. In the case of a biological attack the psychological effects will add to the impact. It is important that health authorities provide concise, understandable and adequate information to the public to avoid overreaction and panic.

Incidents which have international impacts will constitute special challenges for instance concerning communication (language, efficient channels), lack of compatibility of equipment, lack of interoperability, training, tracking of persons, forensic routines, etc. International training and joint exercises are encouraged.

In conclusion, response to chemical and biological attacks could probably be faster, more effective and possibly more cost-efficient for participating members when exchange of information and cooperation for preparedness planning are improved, and resources are pooled.

8 Contact with other projects

WP 7000 is entitled “Contact with other co-operate projects”. The aim is to exchange information with projects primarily within the Western European Armament Organisation (WEAG), later within the European Defence Agency (EDA), and other projects related to countering different aspects of the CBRN threat. The aim is to share information and collect background information and data for the assessments in the present project. During the course of the project there was cooperation with the EDA project “NBC modelling and simulation”. In particular, the results from the dispersion simulation and consequence assessment for one of the scenarios, indoor dispersion of sarin, were used in both projects.[7]

Due to the nature of this work package it was decided not to publish a separate report. An overview of some relevant projects is given in Appendix A.

9 Conclusions and recommendations

There is an increasing concern about the possibility that chemical and biological agents could be used intentionally to cause illness or poisoning of people, civilians or military personnel. A recent study shows that non-state actors share recipes and discuss how to acquire and possibly use biological or chemical weapons.[9] The majority of the reported recipes has technological defects, and will probably not inflict mass casualties. However, the fact that such recipes are published and discussed on the internet, show a certain interest to utilise chemical and biological materials in attacks. Although the probability of chemical or biological terrorist attacks may not be high based on previous incidents and deaths caused by such events, the consequences may be serious, and cannot be overlooked by the military and civil authorities.

The main goal of the project "Counter biological and chemical terrorism project" is to improve the preparedness to counter biological and chemical terrorism for the benefit of safety, security and protection of the civilian society, and defence forces of the participating countries. The overall objective has been is to analyse the threats, possible consequences, emergency preparedness and response measures in the case of terrorist actions using biological or chemical agents, both with respect to procedures, equipment, and training.

The effectiveness and possible consequences of biological and chemical attacks depend on the properties of the threat agent and the method of dispersion. Lists of important biological and chemical threat compounds and their properties have been established and used to develop and select six scenarios. These were discussed and compared in order to analyse emergency response differences and similarities between the nations and identify shortcomings. Dispersion models and hazard prediction and assessment tools can be used before, during and after an event for emergency preparedness planning, response and forensic purposes. The project has established an overview of available models and models used by the participating organisations. The group compared protective equipment, decontamination systems, detection and field identification equipment and medical countermeasures used in the six nations. The project made a comparison of the governing principles of crisis and consequence management, and the strategic, regional and operational emergency preparedness and response to biological and chemical incidents.

Each dispersion model or hazard prediction and assessment tool is designed for specific purposes. It is of crucial importance that the user is aware of the limitations, not only related to the input, but also to the mathematical model itself. Few models have been validated against real spills under operational conditions. Validation of a model requires systematic use of high-fidelity numerical simulations in combination with laboratory and field experiments. Further investigations are needed to scientifically validate the model predictions in real situations. It would be an advantage to establish well validated dispersion models adapted to the variety of climate and terrain across Europe.

In the case of biological detection, technologies and systems must raise an alarm only in the case of aggressive biological aerosols and not “false alarms” due to the natural biological background. The latter may contain species that are biologically close to biological warfare agents, but that are non-pathogenic and occurring naturally. Such species may lure a detection system lacking specificity. Continued efforts to monitor the natural biological background in air is recommended and encouraged.

In conclusion, in order to further improve the preparedness to chemical and biological related terrorism the working group suggests the following:

- To establish a uniform emergency telephone number in Europe
- To arrange recurrent exercises involving the European countries in order to improve the management of many exposed individuals and to identify other capability gaps on the operational level
- To maintain and improve the multilateral epidemiological networks
- To maintain and further develop the networks of designated chemical and biological analytical laboratories for analysis of chemical warfare agents, TIC and infectious agents
- To jointly practise large-scale decontamination, for example at public transport nodes or other public centres. The confident verification of the absence of a toxic substance or an infectious agent is of utmost importance
- To improve the accessibility to, and capability of, decontamination units and medical resources
- To further compare and assess European capability gaps and preparedness to CB(RN) terrorism
- To establish well validated dispersion models adapted to the variety of climate and terrain across Europe
- To continue to monitor the natural biological background in air

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Appendix A Contact with other projects

The subject of work package 7000 “Contact with other co-operate projects” was to gain knowledge about other projects focusing on different aspects of CBRN defence with the purpose of exchanging information and avoid duplication of efforts. For each of the listed projects we have collected the following information:

- Title
- Acronym
- Contributing Members
- Lead nation
- Start Date
- Duration
- Budget
- Contract
- Classification
- Subject
- Summary

The summaries are not included in this Appendix.

These projects are presented depending on its start and completion and categorised in four groups:

- Completed projects
- On-going projects

A.1 Completed projects

TITLE: NBC modelling and simulation
CONTRIBUTING MEMBERS: FI, FR, IT, NL, NO, SP , SE
LEAD NATION: FOI, Sweden
START DATE: 21 December 2005
DURATION: 3 years
BUDGET: 3,150,000 €
CONTRACT: TA113.034 under the EUROPA MOU, transferred to EDA in 2007: EDA-0155-GEM3-ERG
CLASSIFICATION: Up to WEU Secret
SUBJECT: Bearing in mind that over the last years there has been a change of nature of the NBC threat. New scenarios, such as terrorist activities with use of NBC agents or release of Toxic Industrial Compounds (TICs), are now more likely. Organisation and planning of NBC defence activities requires new and reliable tools to predict the evolution and the consequences of an attack or terrorist action, in order to save human lives (civilian and military) and to reserve operational capabilities. The main goals with this project are: • To obtain a better understanding for the uncertainties in NBC-simulations by identifying differences and weaknesses in the model chains used in different countries • Formulate a "Best Practice" i.e. a sort of guideline for how to choose model type in a certain situation and how to interpret the results • Create a sound foundation for continued development of sub models and model chains Secondary goal: If the goals above are obtained early enough in the project a limited joint model development will be performed. Details of this part of the project will be decided on during the project.
SUMMARY: For further information contact FOI, Sweden.

TITLE: Innovative measures for protection against CBRN terrorism
ACRONYM: IMPACT
CONTRIBUTING MEMBERS: NL, UK, DE, FR, ES, FI, SE, IT, BE, CZ
LEAD NATION: TNO, NL
START DATE: 1/12/2004
DURATION: 2 years
BUDGET: 4,308,695 €
CONTRACT: EU PASR Contract nbr SEC4-PR-008000
CLASSIFICATION: Unknown
SUBJECT: The objectives of IMPACT are to lay the foundations for an integrated European CBRN counter terrorism research and acquisition program and to validate, assess and demonstrate innovative technological capabilities, operational concepts and procedures to assist in developing preventive and suppressive crisis management. Current European capabilities to detect and respond to the types of CBRN threats are very modest. Responsibility in Europe for initially responding to terrorist incidents is spread among many organizations. The lack of co-ordination is obvious. There is an urgent need to unify much of the current response capability while at the same time, setting standards and establishing guidelines for European nations to address coordination of their response to terrorism. To address the particular issues surrounding CBRN weapons, Europe must adopt a broad strategy to address the best ways to prevent a terrorist event.
SUMMARY: The IMPACT website: www.impact-eu.com

TITLE: Countermeasures against CBRN/IED
CONTRIBUTING MEMBERS: DIEHL
LEAD NATION:
START DATE:
DURATION:
BUDGET:
CONTRACT: EDA study 05-CAP-009
CLASSIFICATION: EU Restricted
SUBJECT: The study examines the threat and the technical aspects of terrorist Improvised Devices (IDs) which include Improvised Explosive Devices (IEDs) as well as Chemical, Biological, Radiological or Nuclear (CBRN) warfare agents and Toxic Industrial Materials (TIM). In this study "ID" is the short term for "IED/CBR(N)". The general objectives comprise: • Aspects of ID threat (IED alone or in combination with CBR(N) payload) • ID construction, usage and effects • Evaluation of possible counteractive-measures against ID-threat and considerations on consequences of countermeasures for CBR(N) payloads. The report content is: 1. ID threat Analysis 2. Counteractive measures against ID-Threat 3. Scenarios for counteractive measures against IDs a 4. Technologies and available tools 5. Required Capabilities and Technological Gaps. 6. Recommendations
SUMMARY: The unclassified summary report can be obtained from EDA

TITLE: Detection of the improvised explosive devices with CBRN payload
CONTRIBUTING MEMBERS: Prime contractor: Swedish Defence Research Agency (FOI), Sweden Subcontractor: Combitech AB - Sweden Subcontractor: Centre d'Etude du Bouchet CEB France
LEAD NATION: FOI, Sweden
START DATE:
DURATION:
BUDGET:
CONTRACT: EDA study 05-CAP-008
CLASSIFICATION: EU Restricted
SUBJECT: The subject of the study was the detection of IEDs with CBRN payload in order to enhance the capability and capacity of operators so that they can function safely and successfully in an environment containing suspected explosives or non-explosive munitions and devices, both manufactured and improvised (and possibly used in combination with CBRN elements or TIM release). Thus, this study is aimed at improving the understanding of IED construction (explosive part as well as its payload) and shall identify the development of detection techniques for future equipment needed for force protection capability. The summary report content is: Threat analysis • Improvised Explosive Devises (IED) • Improvised Dispersal Devises (IDD) and Improvised Spray Devises (ISD) • CBRN payload • Toxic Industrial Materials payload and other potential fillers Analysis of existing techniques for early detection • Detection of IED • Detection of payload Identification of promising emerging technologies. • Detection of IED • Detection of payload Recommendations
SUMMARY: An unclassified summary report can be obtained from EDA

A.2 Ongoing projects

TITLE: Database of B-agents
ACRONYM: Database-B
CONTRIBUTING MEMBERS: AU, BE, CZ, DE, ES, HU, FR, IT, NL, PL, FI, NO, SE, SP
LEAD NATION: FOI, Sweden
START DATE: March 17 2008
DURATION: 3 Years
BUDGET: 6-8 M €
CONTRACT: EDA ad hoc Category B project
CLASSIFICATION: Up to EU Restricted
SUBJECT: The objective of this project is the establishment of a strategic European bio defence laboratory network; it will improve the European capability to verify the use of B-agents in the context of BTWC In the case of a suspected use of BWA, unambiguous identification of the agent has to be performed. The forensic proof of use of these agents must be such that it cannot be refuted. Microbial forensics has been implemented in the US to ascertain whether an event was natural or intentional and to verify the intentional use of B-agents. Currently, Europe has capability gaps caused by a lack of coordination, standardization, and evaluation of methods to detect, identify type B-agents. Identifying agents and sources in a forensic context relies on a spectrum of features, including epidemiological data and high-resolution analysis. A secure database on B-agents will be established (e.g. sample handling and processing, detection and diagnostic methods, genome sequence and other typing data) to further strengthen the European bio defence capability. In addition, implementation of technical developments in terms of more rapid analysis and higher resolution will be pursued. Creation of a strategic European bio defence network around the database based on agent specific expertise will be the end results of the project.
Summary: More information and summary reports can be obtained from EDA or by contacting FOI, Sweden.

TITLE: Joint investment programme force protection
ACRONYM: JIP-FP
CONTRIBUTING MEMBERS: AT, BE, CY, CZ, DE, EE, EL, ES, FI, FR, HU, IE, IT, NL, NO, PL, PT, SI, SK, SP, SE
LEAD NATION:
START DATE: 1 January 2007
DURATION: 3 years
BUDGET: 54.93M €
CONTRACT: Several EDA Category A projects
CLASSIFICATION: Unknown
SUBJECT: Covers 18 specific research and technology goals (RTG) grouped under five capability areas derived from the Force Protection aim (Collective survivability, Individual protection, Secured tactical wireless communication, Data Analysis including data fusion from various sources, Mission Planning/Training in an asymmetric environment). A Management Committee of one representative of each contributing Member State (cMS), chaired by the EDA, will select the R&T topics for which a call for proposals will be launched by the Agency, decide the share of the budget to be allocated to this call, and authorise the award of contracts based on expert evaluation of the proposals. Decisions will normally be by consensus but, in the event of a vote, the votes will be weighted by the share of the budget of each cMS. A decision will be adopted if the votes in favour represent at least two thirds of the votes and at least half of the cMS.
Summary: More information is available at the EDA website: www.eda.europa.eu

TITLE: Robotized detection of CBRNE Devices
ACRONYM: GUARDED
CONTRIBUTING MEMBERS: ECA, ORSAY (FR) - DDSC, ASNIERES-S-SEINE (FR) - ION, INNSBRUCK (AT) - IPS, LJUBLJANA (SI) - ENV, MIKKELI (FI)
LEAD NATION:
START DATE:
DURATION: 3 years
BUDGET: 3.5M €
CONTRACT: EDA Contract A-0378-RT, under its R&T Joint Investment Programme on Force Protection (JIP-FP).
CLASSIFICATION: Unknown
SUBJECT: The aim of this project is to demonstrate a remote controlled mobile platform for sniffing a suspect and/or dangerous area, having on bard a set of complementary CBRNE sensors to provide a safe diagnostic obtained through data fusion between various sensors, enabling weddings and solving the old paradox of the need for compromising between resolution and detection. Therefore, after a state of the art of various detection techniques allowing to give an overview of what can be detected and how nowadays, use cases scenarios will be established with the help of operational experts to place the project in a realistic context. From then, an intensive trials campaign will conducted. Technologies like Ground Penetrating Radar techniques for localisation, even through walls or buried objects, Proton transfer Reaction coupled with Mass Spectrometry, Chemical and Biological based on handheld devices and improving new sampling techniques etc. will be used. To validate the approach, a trial period is planned after the integration & tests phase, which is traditionally crucial, allowing pointing out and measuring the effects of the project, i.e. completion of the inspection & securing mission.
Summary:

TITLE: European protective individual defence
ACRONYM: EPIDARM
CONTRIBUTING MEMBERS: OUVRY, LYON (FR) - BLUECHER, ERKRATH (DE) – ONERA, CHATILLON (FR) – ISL,SAINT-LOUIS, (FR) - ENSAIT, ROUBAIX (FR) - RMA, BRUSSELS (BE) – AERO SEKUR,APRILIA (IT)
LEAD NATION:
START DATE:
DURATION: 3 years
BUDGET: 3.9M €
CONTRACT: EDA Contract A-0377-RT, under its R&T Joint Investment Programme on Force Protection (JIP-FP).
CLASSIFICATION: Unknown
SUBJECT: EPIDARM deals with R&T on innovative and low cost materials (natural fibres …) and constructions (use of nano particles, 3D textiles structures …) and definition of a multifunctional individual ballistic and CBRNE protective system. The system integrates functions like CBRN modular protection, heat stress regulation and medical monitoring. An early integration scheme will enable to reduce the operational capacity shortfalls, to reduce the weight and improve the overall mobility thanks to lighter and more flexible material already developed in the aerospace Industry. The consortium will integrate End Users (especially from FR, BE, IT and DE MoDs).Demonstrators will be defined and manufactured under technical specifications based on the operational requirements. They will be tested in laboratories (as well as the material and subsystem level) and fielded in real conditions. The consortium intends to industrialize the results of the project.
Summary: