CEN

WORKSHOP

AGREEMENT

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PPE for Chemical, Biological, Radiological and Nuclear, (CBRN) Hazards

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EUROPEAN COMMITTEE FOR STANDARDIZATION
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EUROPÄISCHES KOMITEE FÜR NORMUNG

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Foreword

This CEN Workshop Agreement has been drafted and approved by a Workshop of representatives of interested parties on 2009-12-21, the constitution of which was supported by CEN following the public call for participation made on 2008-06-16/17.

A list of the individuals and organizations which supported the technical consensus are listed below :

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The CWA has been developed through the collaboration of a number of contributing partners in the Manufacture, Use, Testing or those Providing CBRN PPE industries.

The formal process followed by the Workshop in the development of the CEN Workshop Agreement has been endorsed by the National Members of CEN but neither the National Members of CEN nor the CEN-CENELEC Management Centre can be held accountable for the technical content of the CEN Workshop Agreement or possible conflict with standards or legislation. This CEN Workshop Agreement can in no way be held as being an official standard developed by CEN and its members.

The final review/endorsement round for this CWA was started on 2009-10-07 and was successfully closed on 2009-12-21.The final text of this CWA was submitted to CEN for publication on 2009-12-24.

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Comments or suggestions from the users of the CEN Workshop Agreement are welcome and should be addressed to the CEN-CENELEC Management Centre.

Following a resolution being adopted by CEN BT WG 161 Security and Protection of the Citizen, which related to the lack of any guidance on CBRN PPE, consideration was given by DG Justice, Law and Security, who then agreed to make available the funding for this Workshop Agreement.

Introduction

With the ever increasing number of natural disasters, industrial accidents and terrorist attacks, it was stated that there were no specific standards or guides on CBRN PPE (Chemical, Biological, Radiological or Nuclear Personal Protective Equipment) for Manufacturer's, Users, Notified Bodies and those who determine it necessary to provide CBRN PPE which is tested and certified, for selection and use in such events.

As far as legal obligations are concerned, all PPE must comply with the requirements of the PPE Directive 89/686/EEC. For the use of PPE the EU Directive 89/656/EEC has to be complied with. Directive 89/656/EEC excludes PPE for use by Emergency Services, but some EU member states have adopted additional legislation for this purpose.

Consideration was also given to the Medical Services Directive 93/42/EEC with regard to the design and testing of CBRN PPE. Since CBRN products are not considered sterile, self certification applies for most of these products. To overcome the problems of self certification self declaration, any CBRN PPE, even marketed as a medical device, shall be tested and certified by an accredited third party.

The present Standards affording protection against CBRN threats for civilian use are British Standard 8467 (protective clothing), BS 8468 (respiratory protection), NFPA 1971:2007 with the CBRN Option, and an Israeli hood standard certified for CBRN protection (PM-750 Personal Protection Respirator).

There are no standards to give guidance regarding the requirements and testing for proper CBRN PPE, for all categories of personnel who could be involved. This Workshop Agreement makes reference to standards, standards-like documents, legislation, guidance, that should be taken into consideration in order to mitigate the effects (direct or indirect) and consequences of CBRN events on EU Citizens.

There is presently no CEN Technical Committee, or indeed mechanism that can handle "Ensemble" standards, which is the compulsory route when addressing functional PPE that should protect adequately against CBRN. This is a matter that the Commission will need to consider. With the introduction of the new CEN TC 391 Security and Protection of the Citizen, it is felt this could be an avenue where such Ensemble Standards could be developed. However, the workshop gave priority to all individuals who might be engaged in a CBRN incident regardless whether or not these are professional responders or civilians who by job description have a duty to fulfil in such events.

The target audience of this document is therefore widespread and diverse. All stakeholders will need to consider the potential for such a CBRN incident and its impact on their premises and workers, in compliance with applicable regulations.

The members of the Workshop determined that they would develop CBRN PPE to protect the citizen by equipping Professional First Responders, Duty holders, Responsible Persons, Victims and members of the public who were the responsibility of those Occupiers, who had a legal responsibility towards them. The issue of CBRN protection for the citizens of the EU was determined to be too politically sensitive for the CWA to determine any resolution. Instead, the decision was taken to report this matter to DG JLS and this was done by the Chairman in preparation to the final meeting on 23 September 2009. This resulted in a new proposal being prepared by NEN, seeking support from DG JLS for a comprehensive Feasibility study to ascertain present gaps in the provision of CBRN protection for the Citizen and further areas regarding CBRN Detection, Decontamination and protection of Emergency Responders.

It is recognized that there are many potential types of CBRN event/incidents and this CWA has attempted to utilize those risks identified in the IMPACT study conducted by TNO for the EU Commission as a basis for threat levels. See Annex B.

In the initial stages of any CBRN event/incident, it is most unlikely that First Responders, Duty Holders, Employers or Victims would recognize what was involved; therefore the need for preventive CBRN PPE protection has to be considered. There may be occasions when it is imperative to evacuate large numbers of

potential victims, who might be contaminated; the Management of Emergency Services at such incidents is addressed by CWA 16107.

In the initial risk assessment conducted by the responsible person, consideration should be given to the protection for the untrained citizen faced with unknown but presumed pathogenic or toxic substances.

Such protection is defined as non occupational defence during evacuation or emergency movement through the presumed or confirmed hazard to an area of safety. In such circumstances, protection is identified as any device issued by the responsible person/duty holder, with self supply and is recognised as a broad base but limited protection.

At the scene of any incident/event (that turned out to be a CBRN incident) those affected may need immediate assistance in getting away from the hot zone. To achieve this in a hostile environment simple but effective CBRN PPE is required.

In certain scenarios rescues might not be possible until a full dynamic risk assessment has been carried out, this may mean first responders donning full ensemble CBRN PPE to carry out such a risk assessment. The Incident Commander at any such incident would need to give consideration to keeping all persons affected at the incident site within a designated quarantine area.

1 Scope

This CEN Workshop Agreement aims at increasing the protection of those initially and primarily involved with any CBRN incident. This will cover Emergency Responders, Duty Holders, and Responsible Persons, Employers and Victims or potential victims. All of these people are potentially at risk from a CBRN incident.

This CWA provides both general guidance and codes of practice and requirements, testing, marking and certification of PPE to be applied in CBRN situations.

This CWA gives guidance on selection, as well as safety and effectiveness of PPE for CBRN scenarios. For use, care and maintenance the manufacturer's instructions have to be regarded.

This CWA contains guidance and risk assessment templates, which will allow those at risk to determine what level of risk this could be and the PPE required protecting the designated groups we have identified. Additional issues such as instruction, training and use of PPE are also addressed.

The management of any CBRN incident requires a variety of skills and those persons responsible should also refer to CWA 16107.

2 Normative references

The following referenced documents are indispensable for the application of this document. For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

CWA 16107:2010, *Emergency Services Capability Framework*

NOTE CWA 16107 is applicable when considering the roles all of those recognised as having a role whilst attending a CBRN event.

3 Terms and definitions

For the purposes of this document, the following terms and definitions apply

3.1
biological agents
biological materials that are capable of causing an acute disease or long term damage to the human body, the goods and the environment (including animal and vegetal organisms

3.2
CBRN agents
agents of chemical, biological, radiological or nuclear origin that are affecting human, animal or vegetable health by exposure of any kind

C > Chemical Agents
threats by toxic, flammable or explosive chemicals

B > Biologic Agents
threats by fungi, bacteria, viruses or sub-viral particles which may cause health problems

R > Radiologic Agents
threat by compounds which emit radiation which may cause health problems

Nuclear Agents > Atomic degradation Agents
threats by agents which contain elements whose nuclei degrade, emit radiation and form new and potential health threatening compounds or elements

3.3
biological terrorism agents
liquid or particulate agents that consist of a biologically derived toxin or pathogen used to inflict lethal or incapacitating casualties, generally on a civilian population as a result of a terrorist attack

3.4
CBRN PPE
all hardware that can be used by an individual to protect against the exposure to CBRN agents

3.5
chemical flash fire
ignition of a flammable and ignitable vapour or gas that produces an outward expanding flame front, as those vapours or gases burn

NOTE This burning and expanding flame front (fire ball) will produce both thermal and kinetic energy to the environment.

3.6
chemical agents
organic or inorganic substances that can be toxic, explosive, flammable, corrosive, and can cause harm to living organisms and non-living materials/property.

3.7
chemical terrorism agents
liquid, solid, and gaseous and vapour chemical agents and dual-use industrial chemicals used to inflict lethal or incapacitating casualties, generally on a civilian population as a result of a terrorist attack

3.8
citizen
any person within the EU boundaries, legally or illegally; it also referred to animals, which this CWA has not addressed

3.9
cold zone
area where the command post and support functions that are necessary to control the incident are located

[2000 Emergency Response Guidebook, U.S. Department of Transportation]

NOTE This is also referred to as the clean zone, green zone or support zone in other documents (EPA Standard Operating Safety Guidelines, OSHA 29 CFR 1910.120, NFPA 472).

3.10
dual use industrial chemicals
highly toxic industrial chemicals that have been identified as mass casualty threats that could be used as weapons of terrorism to inflict casualties, generally on a civilian population, during a terrorist attack

NOTE Dual-use industrial chemicals can be liquid, solid, or gaseous agents

3.11
emergency response team
fire fighters and other first responders that are trained and equipped to response to incidents involving the accidental release of hazardous materials

3.12
hot zone
area immediately surrounding a dangerous goods incident which extends far enough to prevent adverse effects from released dangerous goods to personnel outside the zone

[2000 Emergency Response Guidebook, U.S. Department of Transportation]

NOTE This zone is also referred to as exclusion zone, red zone or restricted zone in other documents (EPA Standard Operating Safety Guidelines, OSHA 29 CFR 1910.120, NFPA 472).

3.13
radioactivity
energy (radiation) emitted in the form of alpha or beta particles, gamma or X-rays, due to the spontaneous transformation of the atomic nuclei of radioactive isotopes

3.14
radiological agents
agents containing unstable (radioactive) atoms who emit radiation as they decay

3.15
stakeholder
interested parties, more specifically for the purpose of this CWA: any citizen, responder, duty holder, employee or others affected by a CBRN incident

3.16
USAR
Urban Search And Rescue

3.17
victim
fatality, casualty, sufferer, wounded or contaminated person

3.18
warm zone
area between hot and cold zones where personnel and equipment decontamination and hot zone support take place. It includes control points for the access corridor and thus assists in reducing the spread of contamination

[2000 Emergency Response Guidebook, U.S. Department of Transportation].

NOTE It is also referred to as the contamination reduction corridor (CRC, contamination reduction zone (CRZ), yellow zone or limited access zone in other documents. (EPA Standard Operating Safety Guidelines, OSHA 29 DFR 1920.120, NFPA 472).

4 Risk management

4.1 Risk management approach

Toxic Industrial Materials (TIM's) are used across a broad range of industries and establishments and are often relatively easily accessible. Due to their wide use, TIM's are widely available both in and out of the EU. In order to successfully address the broad range of possible TIM's security issues, a risk-management approach is needed based on vulnerability[1)] and threat[2)] assessments in line with existing EU regulations.

1) Vulnerability being defined as the impact an incident could have (taking into account protection and preparedness measures)

2) Threat being defined as the probability that an incident will occur (taking into account capability and intention)

— The assessments being made must acknowledge the lack of internal borders within the EU. For example, due account must be taken of the possibility of acquiring materials in one state and carrying out attacks in another; as well as the effect of an incident close to the physical borders of two countries.

— A comprehensive set of mainly safety related EU legislation exists which are the basis of any risk assessment. Specific safety and security concerns should be addressed separately and in addition to the usual risk assessment.

— The schedules of chemicals included in the Chemical Weapons Convention[3)] , the Seveso II directive and NATO's International Task Force 25 (ITF-25) list of hazardous chemicals could serve as the basis for the identification and prioritisation of TIM's and CBRN warfare agents. Lists of chemicals already existing within the Member States should be taken into account as well.

The risk management process should lead to the identification of toxic agents which may be used for malicious purposes and the consequences of incidents involving such agents. The vulnerability assessment should be conducted based on the development of scenarios, though it is important to underline that so-called "worst case scenarios" may not be adequate with a view to assessing the state of preparedness and protection to low-impact incidents, which may nevertheless cause significant psychological, health and economic effects. The needs should be based on agreed methods and criteria taking the security concern at the EU level into account.

They would also need to take into consideration the basic principle that the danger stemming from a specific toxic agent is to a large extent dependant on the amount and degree of exposure. Toxicity in itself will seldom if ever be a sufficient criterion for singling out a specific chemical agent.

NOTE All carcinogenic substances by definition have no limit values; hence there is no "permissible" exposure level.

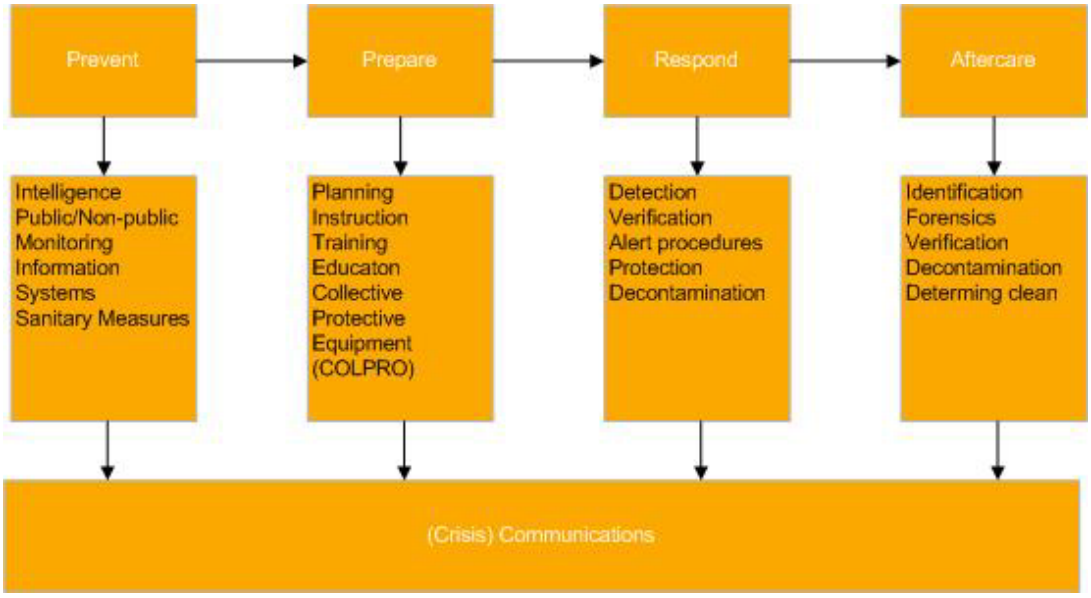

Figure 1 — Intention of this document - Definition of CBRN PPE; context within CBRN protective measures

3) It should be kept in mind that the Chemical Weapons Convention (CWC) schedules were not developed with terrorist risks in mind. Certain chemicals including pesticides and related toxic chemicals do not form part of the schedules.

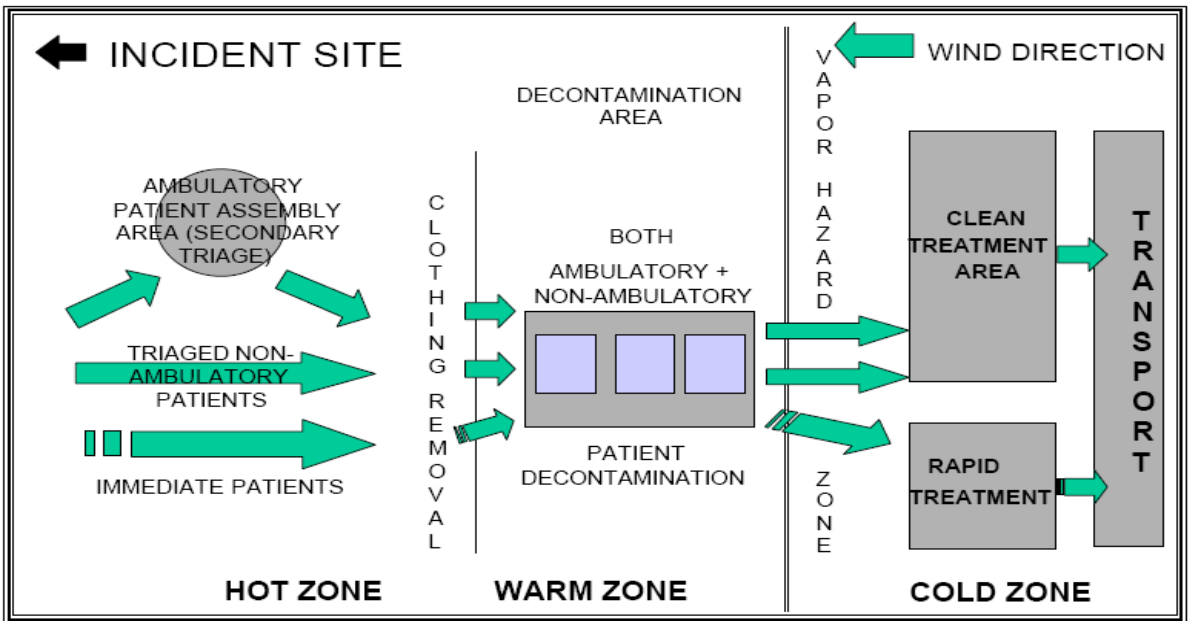

Figure 2 — Classification of zones (hot, warm, cold)

4.2 Classification of zones (hot, warm, cold)

4.2.1 Hot zone

The hot zone is the incident scene.

Management is required to control access to and from the incident scene, control movement of contaminated victims, provide safe working methods for responders and contain the release of any substances.

The boundary of the hot zone (the hot line) shall be clearly marked with tape or by other means to indicate the high risk to responders.

To secure the immediate scene, exclude non-essential personnel and provide a measure of protection for personnel working within the area. Factors to take into account are:

— The boundary of the Inner Cordon will be determined jointly by the Police, Fire Service and Ambulance Service using all available information.

— All those entering or leaving the Inner Cordon will report to a designated cordon access and egress point, which will be controlled by a designated commander, who will register entry and exit. This will ensure that, at all times, people within the Inner Cordon can be accounted for in the event of an escalation of the incident.

— Personnel entering the Inner Cordon are also checked to ensure that they have the appropriate level of Personal Protection Equipment (PPE) and have been briefed on the evacuation signal, hazards, control measures and any other extant issues which they need to be aware.

— Set up Forward Control Points (FCPs) for each agency and establish a routine for inter-agency coordination meetings; where possible, the FCPs should be collocated.

4.2.2 Warm zone

The warm zone is where decontamination is conducted. The boundary of the warm zone – the contamination control line, shall be marked by appropriate means to indicate the potential risk to anyone entering the zone.

An Outer Cordon around the vicinity of the incident to control access to a much wider area around the site. This will allow the emergency services and other agencies to work unhindered and, where appropriate, in

privacy. Access through the Outer Cordon for essential non-emergency service personnel will be through a Scene Access Control Point (SACP). The Outer Cordon may then be further supplemented by an external Traffic Cordon (TC), which will be used by the Police to redirect traffic, control traffic flows and clear key routes into the incident.

4.2.3 Cold zone

The Cold Zone is the uncontaminated area between the Inner Cordon and the Outer Cordon. This is the area where no exposure or risk is expected.

Decontaminated persons will be taken to this area and given assessment, medication and medical advise by medical staff.

5 Threat Scenarios

5.1 General

CBRN events make stakeholders dependent on each other, as no state can have adequate intelligence and early warning of its own.

Bio-agents are readily available in the modern world and are relatively easy to produce, store and transport from one country to another. At the same time, they can be toxic, transmissible and lethal. Some have a long period of incubation, and many items involved in biotechnology are dual use, thus difficult to ban. The physical security of biological agents may be very poor in a number of facilities, with unlocked refrigerators and simple fences without alarm systems surrounding the facilities. Even with efficient border controls it cannot be excluded that illicit trafficking of materials of mass destruction is a possibility.

It is almost impossible to detect and deter the movement and/or transfer of a small quantity of dangerous infectious agents. It is very difficult to forecast consequences of a bioterrorist attack.

Chemical warfare agents and toxic industrial chemicals (TICs) are another category of agents that poses a threat to our societies. Chemical warfare agents are chemicals with no other use than use in armed conflict, while toxic industrial chemicals are the first chemicals that have a peaceful use, while being very toxic and can thus be used in a conflict.

Because of the barriers that exist to produce high quality chemical warfare agents, terrorists have turned to alternatives. These so called Improvised Chemical Devices (ICDs) have a lower toxicity than classical warfare agents and are often characterized by a simple delivery system. ICDs are therefore less dangerous than a high quality agent delivered by a sophisticated delivery system, but remain very dangerous.

A final group of agents are the radiological agents. Basically, there are two groups of use of the agent. The first group are radiological dispersion devices (RDD) that combine explosives with radiological sources, the so called ‘dirty bomb’. The explosion disperses small radioactive particles that can be inhaled or contaminate areas and buildings. The second group are radiating devices. A radio active source is placed (hidden) and will radiate people passing by. Although the damage inflicted is probably lower than the damage from inhalation with a RDD, it still is a very dangerous weapon than can inflict serious injuries and large scale unrest in society.

NOTE Annex A (Informative), Annex B (Informative) and Annex C (Informative) give guidance on risk assessment based on threat scenarios.

5.2 CBRN Categorization

5.2.1 General

CBRN is an acronym meaning chemical, biological, radiological, and nuclear.

C- Chemical: Chemical gases, vapours and particles of chemical warfare agents and toxic industrial materials.

B- Biological: Biological agent particles such as micro-organisms or toxin products.

R- Radiological: Radioactive particles such as particles carrying alpha or beta radioactive isotopes dispersed by various means such as a radiological dispersive device, also known as a “dirty bomb”.

N- Nuclear: Radioactive material such as the radioactive particles transported/dispersed from a detonation involving a nuclear reactor/fuel, a nuclear weapon, or a nuclear weapon’s component or component precursor.

5.2.2 Biological threats

Bioterrorism agents/diseases are defined in three categories: [4]

— Category A comprises high priority agents that “include organisms that pose a risk to national security because they can easily be disseminated or transmitted from person to person; result in high mortality rates and have the potential for major public health impact; might cause public panic and social disruption; and require special action for public health preparedness. The CDC, Centre of Disease Control in the US) lists the following under Category A: Anthrax (*bacillus anthracis*), Botulism (*Clostridium botulinum* toxin), plague (*Yersinia pestis*), Smallpox (*variola major*), Tularemia (*Francisella tularensis*) and Viral hemorrhagic fevers (filoviruses e.g. Ebola, Marburg and arenaviruses e.g. Lassa, Machupo.

— Category B diseases/agents are defined as those that “are moderately easy to disseminate; result in moderate morbidity rates and low mortality rates; and require specific enhancements of CDC’s diagnostic capacity and enhanced disease surveillance. ”Category B includes: Brucellosis (Brucella species); Epsilon toxin of *Clostridium perfringens*; Food safety threats (e.g. Salmonella species, *Escherichian coli* 0157:H7, Shigella); Glanders (*Burkholderia mallei*) Melioidosis (*Burkholderia pseudomallei*);Psittacosis (*Chlamydia psittaci*); Q fever (*Coxiella burnetii*); Ricin toxin from *Ricinus communis* (castor beans); Staphylococcal enterotoxin B; Typhus fever (*Rickettsia prowazekii*); Viral encephalitis (alphaviruses e.g. Venezuelan equine encephalitis, eastern equine encephalitis, western equine encephalitis; Water safety threats (e.g. *Vibrio cholera*, Cryptosporidium), Influenza (H1N1).

— Category C, are defined as “emerging pathogens that could be engineered for mass dissemination in the future because availability; ease of production and dissemination; and potential for high morbidity and mortality rates and major health impact. The CDC list mentions emerging infectious diseases such as Nipah virus and hanta virus. Apart from the CDC classification, attention is brought at the European classification of biological agents, presented in the European Directive 2000/54.

5.2.3 Chemical threats

Chemical scenarios include:

— deliberate release of illegally obtained or manufactured chemical warfare agents

— the release of purchased or stolen industrial chemicals;

— attacks on chemical manufacturing plants, storage sites or transport vehicles;

[4] The United States Center for Disease Control and Prevention

— malicious use of chemicals to contaminate food or water sources.

— industrial chemical accidents.

5.2.4 Radiological/nuclear threats

5.2.4.1 Radiological Dispersal Devices (RDD)

A Radiological Dispersal Device (RDD) is a conventional bomb not a yield-producing nuclear device. RDDs are designed to disperse radioactive material to cause destruction, contamination, and injury from the radiation produced by the material. An RDD can be almost any size, defined only by the amount of radioactive material and explosives.

A passive RDD is a system in which unshielded radioactive material is dispersed or placed manually at the target.

An explosive RDD-often called a "dirty bomb"-is any system that uses the explosive force of detonation to disperse radioactive material. A simple explosive RDD consisting of a lead-shielded container-commonly called a "pig"-and a kilogram of explosive attached could easily fit into a backpack. An atmospheric RDD is any system in which radioactive material is converted into a form that is easily transported by air currents.

Use of an RDD by terrorists could result in health, environmental, and economic effects as well as political and social effects. It will cause fear, injury, and possibly lead to levels of contamination requiring costly and time-consuming cleanup efforts.

A variety of radioactive materials is commonly available and could be used in an RDD, including Cesium-137, Strontium-90, and Cobalt-60.

Hospitals, universities, factories, construction companies, and laboratories are possible sources for these radioactive materials.

5.2.4.2 Improvised Nuclear Device (IND)

An IND is intended to cause a yield-producing nuclear explosion. An IND could consist of diverted nuclear weapon components, a modified nuclear weapon, or indigenous-designed device.

INDs can be categorized into two types: implosion and gun assembled. Unlike RDDs that can be made with almost any radioactive material, INDs require fissile material-highly enriched uranium or plutonium-to produce nuclear yield.

5.3 Incident scenarios

In the previous sections, different aspects and variables of the threat spectrum were discussed. When we look at the threat spectrum and realize how many different variables need to be considered main drivers of an incident, the threat spectrum seems enormous and unmanageable. Considering twenty five different agents, ten different delivery methods, ten different types of targets, five different levels of resilience, and four different stages of readiness and ignoring all the other variables, this would still lead to 50 000 different combinations. Even if 90 % of these combinations were unfeasible, technical not realistic or not possible for other reasons, it would still leave 5 000 combinations to cover.

This is the reason why scenario sets are developed. These sets try to cover as much as possible from the threat spectrum with a limited number of scenarios. Scenario sets can be divided into three categories. The first set consists of military scenarios and includes different scenarios with classical agents and non conventional agents for different missions. An example of such a set is the ITF 137 Chemical, Biological and Radiological Scenarios for Operations Other Than War. The second set consists of scenarios for civil use with conventional agents (chemical warfare agents and TICs). Examples of this type of sets are the IMPACT scenarios and the US National Planning Scenarios. The final set of scenarios uses conventional and non conventional (improvised) agents, non lethal agents, hoaxes and is the most complete set of scenarios for civil use. An example of this set is the IB Consultancy CBRN Planning Scenarios Collection.

Scenarios can be used for different purposes. They can be used for planning, training, procurement (of PPE and other equipment), design of security measures and policy development. When a scenario is combined with a specific object, modelling can be used to estimate the impact of a certain scenario and to test counter measures (such as PPE) in a virtual environment.

The modelling can provide the user with concentration time profiles (CT profiles) that can be used as an input to toxicological models to determine impact on people:

— CBRN warfare, CBRN terrorism, accidents with CBRN materials, diseases refer to 'IMPACT' scenarios, as examples regarding what could happen in terrorist scenarios.

— Incident scenarios qualitatively.
All toxic substances shall be considered here: Chemical, Biological (living as well as dead material, causing contagious as well as non contagious disease) as well as radiological agents. We exclude however the protection against the effects of a nuclear weapon detonation.

— Identification of hazard; intoxication mechanism, way of penetration into body.
All the 'portes d' entree' of the human body are of relevance (respiratory tract, skin, mucous tissue and eyes). PPE will however not protect against the intake of poisonous food or beverages. In addition, the protection PPE could provide against infection by vectors. Insect bites will not be covered.

— Incident scenarios quantitatively; concentration & duration.
Any CBRN incident will occur over a period of hours to weeks. The duration of PPE is limited therefore, this aspect needs to be considered and addressed.

5.4 Identification of hazards

— Type of hazards

— Dissemination of agent, gases/vapours, liquids, droplets, aerosols Vector – (transportation mode)

— Target

— Indication or alert of event

— Effects

— Evolution of the scenario

— Duration of danger (persistency)

6 Stakeholders in an Incident

6.1 Categories of stakeholders

— Duty holders with general, site related, non CBRN specific, operational responsibility (sentry, porter, site manager)

— Initial responders with incident related, non CBRN specific responsibility (Guard, First Aid employee, Police, Ambulance team)

— Professional CBRN responders: CBRN capable, emergency response Teams (HAZMAT teams, military, decon-teams)

— Emergency services: but with no specific CBRN capabilities (ordinary fire-fighters, First Aid hospital personnel, USAR)

— Victims; individuals that are mobile or already incapacitated, affected by the CBRN incident and may therefore have specific protection

6.2 Explanation

The reason for introducing the above five categories of personnel who are exposed to a specific incident, is that they have completely different tasks. Typically, this requires different PPE because of varying exposure times in the hot/warm zone. This is a consequence of the difference in their roles at the scene of the CBRN incident their duty and level of expertise regarding mitigating the consequences of CBRN incidents. There are three actual decisive parameters:

— designated responsibility of the stakeholder;

— awareness, knowledge & training to use PPE;

— time (duration) that as a consequence of professional responsibility has to be spent at the incident site.

For the different categories, this reads as follows:

Category 1, the duty holders:

A very short time on the scene (alarming), evacuation only, no responsibility to mitigate any CBRN effects, basic training is required. CWA 16107 should be considered when pre planning for any potential CBRN incident.

Category 2, initial responders:

A limited time on the scene (initial reconnaissance & rescue), no responsibility to mitigate the CBRN source, a suitable level of PPE and training.

Category 3; professional CBRN responders:

An extended period of time and exposure at the scene; directly mitigating the source / contamination / contaminated casualties; trained to use sophisticated equipment.

Category 4; emergency services:

A prolonged period of time on the scene; no direct mitigation of CBRN effects; a suitable level of PPE and training.

Category 5; victims or potential victims:

Unknown exposure time on the scene (non ambulant); no mitigation; insufficient awareness; reduce the risk of further exposure.

6.3 Targets to be protected

Regarding the tasks, responsibilities, competences, knowledge and experiences, the protection required and appropriate PPE will be different for the categories of exposed persons.

The three aforementioned parameters (6.2) define, per category, the required performance (qualitative & quantitative), as well as the level of complexity, ease of use of the appropriate PPE.

Table 1 is a best estimate to indicate the process time of various categories of stakeholders at an incident scene

Table 1 — Estimated time at the incident scene

Duty holder	**5 min to 15 min warm zone**
Initial responder	**5 min to 15 min warm zone, arrives directly after onset of incident, probable contact with casualties**
Professional CBRN responder	**30 min hot zone, 1 h to 2 h warm zone, arrives +15 min after incident**
Emergency services	**3 h warm zone, +15 min after incident, contact with casualties**
Victims and potential victims	**15 min or site specific requirements assessed by duty holders**
Clean-up Work	**As long as necessary to return the site to it's original state, free of CBRN hazards**

7 Selection of PPE in CBRN incidents:

7.1 General

The products listed below are examples, which PPE shall be considered for the various functions and duties in an incident. If, however, the risk assessment reveals specific risks which are not covered by the listing below, PPE with higher protection factors should be selected.

NOTE As a general rule it is recommended that if in doubt, PPE with higher protection should be selected.

7.2 Selection of PPE for personnel in a CBRN incident

Table 2 proposes existing PPE for all stakeholders in an incident. This information is a starting point to select PPE. The risk assessment process must allow the emergency services to conduct dynamic risk assessments, which could lead to adjustments, particularly for emergency services personnel, but might also impact on others at the CBRN scene

Table 2 explains existing PPE and their related standards for non-CBRN applications. For use at a CBRN incident, additional and specific CBRN testing and certification is required.

Selection is based upon the minimum Nominal Protection Factor (NPF), in case of RPE, required for the individual personnel on and at the incident.

NOTE 1 Nominal protection factors are chosen because there are no consolidated European assigned protection factors (see EN 529:2005). If more than one item of CBRN PPE Is being worn, the user needs to make sure that the different items of PPE are compatible with each other.

NOTE 2 A serious gap has been identified, since there are no standards for the requirements and the testing of PPE ensembles, either for CBRN, or non-CBRN.

Table 2 — Table for selection

Persons	**Minimum NPF (RPE)**	**PPE**	**Proposed Applications/ Comments**
Duty Holder	500	PAPR TH3 (EN 12941) BS 8468-4, type 1: PAPR with Hood, Blouse or Suit - e.g. type 3 (EN 14605) or type 5 (EN 13982-1) preferable: BS 8468-3.1 emergency escape breathing device with hood (NPF 2000) Isr. Standard PM-750 type II and type III Basic head protection (EN 397, EN 812)	5 – 15 min warm zone gas born: type 3 particle born; type 5 dependent on the kind of the threat
Initial responder	1000	Full Face Masks with Filter(s)w. Filters (EN 136; EN 14387; filter type B2-P3) preferable: BS 8468-2 with ensemble: Helmet (EN 443) Gloves (EN 374, EN 388); Footwear (EN ISO 20345 Code II, D,P,A E; alternatively EN 15090, type 2 II D; Suit/garment type 4 (EN 14605)	5 – 15 min warm zone
Professional CBRN responder	10000	SCBA, positive pressure + Suit type 1 ET (BS 8468-1 + EN 943-2) or Closed Circuit Breathing Apparatus (CCBA) (based on BS 8468-1, EN 145)+ Suit type 3 (+ EN 14605) with ensemble: Helmet (EN 443) Gloves	30 min hot zone 1 – 2 hours warm zone

Persons	Minimum NPF (RPE)	PPE	Proposed Applications/ Comments
		(EN 374, EN 388), Footwear (EN ISO 20345 Code D,P,A E; alternatively EN 15090, type 2 II D. BS 8467-1 CBRN protective Clothing or NFPA 1971;2007 with CBRN option	
Emergency services	2000	PAPR TM3 (EN 12941) preferable: BS 8468-4, type 2: PAPR with Full Face Mask, with ensemble: Gloves (EN 420, EN 388, EN 374-2, EN 374-3) NOTE Special care is needed to choose the correct type of gloves (minimum pinhole AQL possible, maximum tear resistance, resistance to chemicals at risk of contact as well as disinfectants. Consider double-donning); Footwear (EN ISO 20345 Code II, Cat S2; alternatively EN 15090; Suit/garment type 4 (EN 14605). Full Face Masks with Filter(s) (EN 136; EN 14387; filter type : B2-P3)	3 h warm zone
	1000	preferable: BS 8468-2, with ensemble: Gloves (EN 455); Footwear (EN ISO 20345 Code II, Cat S2; alternatively EN 15090; Suit/garment type 4 (EN 14605). BS 8467-1 CBRN protective Clothing and NFPA 1971:2007 with CBRN option	

Persons	Minimum NPF (RPE)	PPE	Proposed Applications/ Comments
Victims	50*	Escape Hood (draft BS 8468-3.2) Escape device (DIN 58647-7) Escape Hood (draft ANSI/ISEA 110-2009) Isr. Standard PM-750 type II and type III	15 min. warm zone depending on the kind of the threat
Clean-up Work	dependent on the kind of the selection	SCBA + Suit type 1 ET (EN 137+EN 943-2) Or Full Face Mask with Filter(s) + Suit type 3 (EN 136; EN 14387 + EN 14605) Or PAPR TM3 + Filter(s) + Suit type 3 (EN 12941 + EN 14605) Or SCBA + Suit type 3 (EN 137 + EN 14605) or CCBA + Suit type 3 (EN 145 + EN 14605) with ensemble: Basic head protection (EN 397, EN 812); Gloves (EN 374; EN 388); Footwear (EN ISO 20345 Code II,D,P,A E; alternatively EN 15090, type 2 II D BS 8467-1 CBRN protective Clothing and NFPA 1971;2007 with CBRN option	Selection depending on risk assessment

NOTE 3 These are minimal protection levels. Depending on the circumstances, higher protection factors may be required. This will have consequences for the PPE to be provided.

8 Performance requirements - Protection

Only first responders, professional CBRN responders and emergency services in suitable CBRN PPE should enter the warm and hot zone of an incident/event. For this purpose, the ergonomic design of the PPE should allow the wearer to work in the warm and hot zone for the required period of time.

The appropriate number of professionals CBRN responders should be equipped with CBRN – suitable PPE to allow them to enter the incident/event without delay. Because it is difficult to predict which situation these responders are encountering when arriving at the incident/event, at least a basic level of PPE is necessary to avoid those becoming victims themselves.

NOTE 1 Alarm sensors will be required to obtain information about the presence (and possibly concentrations) of CBRN agents. This will allow a decision to be made as to the required PPE.

NOTE 2 Communications will be necessary to ensure intra and inter-organisational communication between team's members at a CBRN incident/event and to a command post outside the incident/event. Communication devices should be compatible to the PPE.

9 Requirements

9.1 CBRN Requirements

All PPE shall be tested and certified in accordance with existing EN standards. Additionally, they shall comply with national CBRN standards for testing from USA, United Kingdom or Israel, since no European CBRN standards are available. The suitability of these CBRN standards shall be discussed and agreed upon with the notified body involved with the certification and supervision of the quality system.

9.2 Marking

PPE for use in CBRN incidents shall be clearly marked "CBRN" with reference to this CWA. The information supplied by the manufacturer shall indicate what the PPE have been tested for. The instructions for use shall explain which standards have been used for testing and certification. The intended use and limitations of the product shall be clearly mentioned.

NOTE If symbols are used, it is strongly recommended that the symbols used in EN 420 for the protection against chemical, biological and nuclear threats.

10 Training

Appropriate levels of training should be undertaken by stakeholders on the CBRN PPE there are to use.

Training should encompass:

- Selection and use of PPE in CBRN incidents;
- CBRN threats and Hazards;
- Decontamination (personal);
- Disposal of used PPE (where applicable);
- Evacuation;
- Interaction with Emergency Response Teams and Services;
- S.I.P – Shelter in Place;
- Resilience.

See also CWA 16107 related to training and exercises.

11 Recovery

For recovery, the following points shall be considered, plus any additional ones identified in the Risk Assessment:

- Safety conclusions as a result of risk assessment;
- Selection of PPE;
- Determination of hot, warm and cold zones;
- PPE management;
- Environmental regulations;
- Disposal, decontamination of CBRN PPE;
- Dynamic Risk Assessment.

Annex A
(Informative)

The following is a template example to facilitate CBRN risk assessment

CBRN RISK ASSESSMENT

PREMISES RISK INFORMATION

1. Business/Area type	
2. Building/Area	
3. Address	
4. Postcode	
5. Station area	
6. Grid reference	

When completing the boxes below it should be noted that this relates to the risk to the five groups identified by this CWA once the premises are involved in a CBRN incident/event

Principal Significant Hazards to Stakeholders	**Hazard Rating (1 to 5)**	**Probability rating (1 to 5)**	**Risk Factor (Hazard x probability) (1 to 25)**	**PPE Level (1 to 5)**
Building Collapse				
Explosion				
Flashover/Backdraught				
Contamination				
Safe Haven				
Rapid fire spread				
Undetected fire spread				
Building Construction				
Complex/Difficult Layout				
Basement				

Chemicals				
Large Open Spaces				
Ventilation				
Occupancy				
Inter Agency Operations Required				
Management				
Lack of Water Supplies				
Poor Storage Practice				
Microbiological (Pathogens etc.)				
Signature of person completing form **……..** **Date……**	**Premises Total Risk Factor. A Category 2 plan should be completed for premises where the result is between XXX and XXX. A Category 3 plan must be completed if this figure is XXX or above**			**Signature and recommendation of Station Commander.** **Category 2 plan required?** **Yes No** **Category 3 plan required?** **Yes No** **……..**

Additional Information

Name of duty holder
Description of Duty holder's duties
Contact details
Location of emergency plan
Location of stored PPE
Location of Safe havens
Plan review date

Annex B
(Informative)

B.1 HAZARD SEVERITY TABLE

HAZARD SEVERITY		RATING
CATASTROPHIC	Imminent danger exists, hazard is capable of causing death and illness or difficulties in operations on a wide scale	5
SEVERE	Hazard can result in serious illness, severe injury and property and equipment damage or difficulties in emergency operations	4
SIGNIFICANT	Hazard can result in significant illness, severe injury and property and equipment damage or difficulties in emergency operations	3
MINIMAL	Hazard can cause illness, injury or equipment damage, but the results would not be expected to be serious. Limited difficulties in emergency operations could be experienced.	2
INSIGNIFICANT	Hazard would not result in serious injury or illness, remote possibility of damage beyond minor first aid case. In normal circumstances no difficulties in emergency operations should be experienced.	1

NOTE This Risk Assessment process has been derived from those Safety systems used throughout the EU and UK and endorsed by UK Health and Safety Regulators (HSE)

B.2 PROBABILITY RATING TABLE

PROBABILITY		RATING
VERY LIKLEY TO OCCUR	If the building is involved in a CBRN incident the event is very likely to occur immediately or shortly. In an incident this event will occur on the vast majority of occasions	5
PROBABLE	If the building is involved in a CBRN incident the event is likely to occur immediately or shortly	4
REASONABLY PROBABLE	If the building is involved in a CBRN incident the event probably will occur in time	3
REMOTE	If the building is involved in a CBRN incident the event may occur in time	2
IMPROBABABLE	If the building is involved in a CBRN incident the event is unlikely to occur	1

B.3 RISK FACTOR INTERPRETATION TABLE FOR DETERMINING CONTROL MEASURES FOR INDIVIDUAL HAZARDS

Risk Rating	Interpretation
15 to 25	Identified risks are not acceptable. Further control measures are required. Immediate action must be taken. Re-assess following implementation of control measures.
8 to 12	Is the risk justifiable? If not, further control measures are necessary. Re-assess following implementation of control measures. If acceptable re-assess at review date.
1 to 6	No further control measures are required. Re-assess at review date.

Annex C
(Informative)

Examples of the magnitude of hazards

When the event occurs inside confined spaces, concentrations of any threat can theoretically build up to fairly high and dangerous concentrations. For outside events, climatic conditions have to be taken into account. By the time the professional (and probably even the initial) responder arrive, there is no solid information available as to the type and magnitude of the hazard(s). It may only be deposited by aerosol on surfaces, clothing and casualties. It may be droplets, liquids, gases or vapours). The usual classification of “hot zone”, “Warm zone” and “Cold zone” applies with the exception that mobile casualties can form a “hot zone” on their own because of contaminated clothing, skin and hair (blood and urine will not be toxic or contagious right away as the agents still needs to redistribute and B-agents need to develop in the body. Sputum and slime will however be toxic).

For a 1 kg VX source within 100 m: 1400 mg/m^2 ground contamination for 1 kg low volatile agent explosively discharged. Within 100 m: VX lethal dose within 1 min after emergency at 300 m: 14 mg VX/m^2 ground contamination, main contamination from clothes mobile casualtiesR: for an explosively dispersed 1 kg most dangerous radiation source, radiation at 100 m from the event will be 100 mSievert due to aerosol cloud (direct after explosion) and direct radiation. For the re-aerosolising particles, a respiratory particle protection is needed. Skin protection will offer some protection against deposition of particles and will ease decontamination, but for the highly penetrating radiation only the ALARA principle (>distance, <time) will protect.B: microbes will be diluted by a factor 10 000 in the first 30 m from the event. For a 1 kg source of highly infective agent 50 m downwind a respiratory particle protection factor of 10 000 is needed.

Concentrations of volatile TIC (acrylonitril, ammonia, chlorine, hydrogen chloride, hydrogen cyanide) out of a fully ruptured 20 t truck can result in 1 km downwind concentrations during the first 30 min after the event which the capacity delivered by usual ABEK-2 filters can barely cope with. Depending on the agent, the initial concentrations will have decreased by a factor 2 to 10 in 120 min to 150 min timeframe after the event, resulting in a need for a respiratory protection factor of 2 to 55. Closer to the event the concentrations increase (clouds might linger on) and protection factors up to 2000 might be needed at 100 m distance .At the 1 km distance, only highly toxic and fat soluble agents like hydrogen cyanide also require some skin protection (PF 2) in the period directly after the event. Of course, closer distances and touching of liquid or aerosol contaminated casualties might require skin protection as well to keep body uptake (which is less than the direct contamination) below 10 mg to100 mg.

Bibliography

Direct relevance for CBRN protection (number and title of standards and other deliverables):

AEP-38 Volume I:2009 (Allied Engineering Publication)

Operational Requirements, Technical Specifications and Evaluation Criteria for CBRN Protective Clothing

ANSI/ISEA 110:2009

Air-Purifying Respiratory Protective Smoke Escape Devices (RPEDs)

BS 8467-1:2006

Protective clothing. Personal protective ensembles for use against chemical, biological, radiological and nuclear (CBRN) agents. Categorization, performance requirements and test methods

BS 8468-1:2006

Respiratory protective devices for use against chemical, biological, radiological and nuclear (CBRN) agents - Part 1: positive pressure, self contained, open-circuit breathing apparatus – Specification

BS 8468-2:2006

Respiratory protective devices for use against chemical, biological, radiological and nuclear (CBRN) agents - Part 2: negative pressure, air purifying devices with full face mask – specification

BS 8468-3.2

Respiratory protective devices for use against chemical, biological, radiological and nuclear (CBRN) agents - Part 3.1: Air-purifying devices incorporating a hood for escape – Specification

NOTE This draft standard is similar to EN 403 (Smoke Hood)

BS 8468-4:2008 (PAPR with hood = type 1; PAPR with mask = type 2)

Respiratory protective devices for use against chemical, biological, radiological and nuclear

(CBRN) agents – Part 4: Powered air purifying respirators – Specification

DIN 58647-7:1997

Atemschutzgeräte für Selbstrettung - Teil 7: Fluchtfiltergeräte Anforderungen, Prüfung, Kennzeichnung

EN 136:1998

Respiratory protective devices — Full face masks — Requirements, testing, marking

EN 140:1998

Respiratory protective devices - Half masks and quarter masks - Requirements, testing, marking

EN 145:1997

Respiratory protective devices – Self-contained closed-circuit breathing apparatus compressed oxygen or compressed oxygen-nitrogen type – Requirements, testing, marking.

EN 405:2001+A1:2009

Respiratory protective devices - Valved filtering half masks to protect against gases or gases and particles - Requirements, testing, marking

EN 340:2004

Protective clothing - General requirements

EN 529: 2005

Respiratory protective devices – Recommendations for selection, use, care and maintenance – Guidance document

EN 943-2:2002

Protective clothing against liquid and gaseous chemicals, including liquid aerosols and solid particles - Part 2: Performance requirements for "gas-tight" (Type 1) chemical protective suits for emergency teams (ET)

EN 12941:1998

Respiratory protective devices - Powered filtering devices incorporating a helmet or a hood - Requirements, testing, marking

EN 14387:2004+A1:2008

Respiratory protective devices - Gas filter(s) and combined filter(s) - Requirements, testing, marking

EN ISO 13982-1:2004

Protective clothing for use against solid particulates - Part 1: Performance requirements for chemical protective clothing providing protection to the full body against airborne solid particulates (type 5 clothing) (ISO 13982-1:2004)

AAP-21(B):2009

NATO glossary of chemical, biological, radiological and nuclear terms and definitions English and French

NFPA 1991:2005

Standard on Vapor-Protective Ensembles for Hazardous Materials Emergencies

NIOSH

NIOSH Air-Purifying Escape Respirator (APER) with CBRN Protection dated (2003)

NIOSH Air-Purifying Respirator (APR) with CBRN Protection (2004)

NIOSH Powered-Air-Purifying Respirators (PAPR) with CBRN Protection (2006)

NIOSH Self-Contained Breathing Apparatus (SCBA) with CBRN Protection (2001)

PM-750 (Israeli standard):2009

Personal protection hood mask – Specification

Indirect relevance for CBRN protection (number of categorized standards and other deliverables):

In addition to the Standards mentioned above the following list of standards may well form part of the over all recommendation for the provision of protection.

Terms and definitions

NATO document PFP (NAAG-LG7) N (2003) 1

Respiratory protection

– Particle protection

• EN 143, , EN 149, EN 405, EN 14387, EN 1827

– Gas/vapour protection

• EN 12941, EN 12942, EN 14387

– Air supply

• EN 140, EN 136, EN 14594, EN 12941, EN 12942

Hand protection

– Chemical protection

• EN 374-1/3, EN 420,

– Fire-fighters, Heat

• EN 659, EN 407, EN 12477

– Mechanical Risks

• EN ISO 10819, EN 388

– Ionizing radiation, radioactive Contamination

• EN 421

Body protection

– Chemical protection

• EN 943-1/2, EN 14605, EN 13982-1/2, EN 13034

– Bio-Protection

• Like Chemical plus EN 14126

- Nuclear protection
  - Like Chemical plus EN 1073-1/2
- Heat & Flame protection
  - EN 367, EN 373, EN 469, ISO 11612, EN ISO 14116
- High Visibility
  - EN 471

– Cold & Foul Weather

• EN 342, EN 343, EN 14360

Head protection

- Helmets

• EN 397, EN 443, EN 812