

DECONTAMINATION IN THE EVENT OF CBRN INCIDENT

Lyudmila SIMEONOVA
simeonoval@gmail.com

Abstract

The information referred to in this article was used when teaching the course "Specialized Training Session Sixth for the Prevention of Weapons of Mass Destruction for Civil Defence Officers Gulf Cooperation Council for the Arab Gulf States", which was held in Kuwait from 30th November to 12th December 2014.

The Cooperation Council for the Arab States of the Gulf invited 'NATO's Civil Protection Group' to provide a training course for the staff of Civil Protection focused on protection against weapons of mass destruction. The training took place at the training centre of the Ministry of Interior in Kuwait with the participation of representatives of the four Gulf States: Kuwait, Saudi Arabia, United Arab Emirates, and Bahrain. Officers from various authorities including the National Guard, Army, Police, Customs Department, Fire Department, and Medical Emergency took part in the training. The course consisted of practical and theoretical sessions and was presented by experts of the training team of the civil protection group of NATO in cooperation with the Fire Department and the Hazardous Materials Center. It aimed to train the officers and improve their skills in civil protection so they would be able to deal with weapons of mass destruction and other dangerous materials and get rid of its effects.¹⁾

Lessons were based on the "Guidelines for First Responders to a CBRN Incident" developed by the 'NATO's Civil Protection Group', whose member is also the author of this article. The article focuses on the area number 3 in the "Guidelines for First Responders to CBRN Incident" entitled "Scene Management: Isolate scene to mitigate the Consequences".

The aim of the response guidelines is to establish procedural guidelines for midlevel strategic/tactical planners responsible for CBRN preparedness and response. The response guidelines provide generic advice and guidance on procedures, capabilities and equipment required to implement an effective response. They are designed to improve multi-agency interoperability in first response to a CBRN incident and provide guidance on when regional, national or international assistance may be required. The guidelines have been prepared to help planners in EAPC nations determine their own level of capability through self-assessment. They serve as a checklist. Implementation of the guidelines is entirely optional.²⁾

Key words

Decontamination, CBRN incidents, emergencies, protection, contamination.

INTRODUCTION

The general availability of chemical, biological and radiological agents, their precursors and dispersal equipment, coupled with increasingly accessible subject knowledge provide groups and individuals villainous intentions the ability to inflict the mass casualties on society. Training and flexible emergency response is the basis of any effective frontline defence against this. First responders must be prepared and all communities must anticipate, develop and plan integrated response plans that can deal with chemical, biological or radiological attack. Survival of persons in the environment contaminated by toxic substances is among others also a subject to proper decontamination.

1 TYPES OF CONTAMINATION WITH HAZARDOUS SUBSTANCES

Contamination is transfer of hazardous materials from their sources by humans, animals, equipment or environment that can become infected with the corresponding contamination. There are following types of contamination:

A. Primary / direct / contamination

- The primary contamination is a direct transportation of hazardous substances on humans, animals, equipment and environment;
- First responders can be contaminated when passing through the liquid spills of hazardous substances, clouds of vapour, liquid spray / aerosol /smoke from burning substances, particulate matter and particles of contaminated equipment and environment.

B. Secondary contamination

- Secondary contamination occurs from the hot zone through the clothing of personnel, equipment, air currents and outgoing water;
- If the staff is not decontaminated before leaving the hot zone they can contaminate everything and everyone with which or whom they are in contact.

Surface contamination and absorption

- **Surface contamination** is limited to the surface. In this type of contamination there is no leak, penetration, wetting of the material;
- **Infiltration** occurs due to the effect of different types of chemicals / liquids and gases especially / in contact with a porous / absorbent / material.

2 DECONTAMINATION

Decontamination is performed in cases of danger to life, health, property or the environment arising from the nature of hazardous substances and prevents the spread of them. Responsible person who decides to perform decontamination on-site of the intervention is a commander. People are contaminated with radioactive substances, if dosimetric control of contamination of surface activity demonstrates the value of greater than 3 Bq / cm².

Policies, procedures and operations measures for decontamination are listed in the methodical sheets respectively model activities.

The life of decontamination agents is determined by the manufacturer's instructions. In case of decontamination agents based on hypochlorite containing active chlorine, the concentration of the decontamination solution is calculated so that the concentration of active chlorine in ready discriminatory decontamination solution to be min. 2.5% wt., unless specified by special regulation.

Ideally, decontamination should take place at remove location within the warm zone. It should be upwind from the incident site and situated on higher ground and far enough away to be safe from any secondary structural collapse. Consideration might be given to using a location with facilities that could assist with decontamination, e.g. car washes, swimming pools, fountains, indoor parking lots with sprinkler system.

2.1 METHODS OF DECONTAMINATION

DECONTAMINATION is rapid and effective removal or neutralization / disposal / of the contaminant to reduce the spread of pollution and its reduction to a lowest possible level. The procedure for the implementation of decontamination vary depending on the pollutant.

According to the embodiment, decontamination can be either dry or wet process. Dry methods are mainly mechanical, e.g. suction or wiping to dryness. The wet methods include the use of mixtures, solutions, foams, water vapour, wiping, spraying. Wet decontamination is predominantly performed by special units. Then there are physical or chemical procedures of decontamination. Besides, there are also natural ways.

Nature decontamination methods can be described as processes which are not affected by man, but are caused by involuntary processes which take place either on the basis of certain conditions in the point of leak (e.g. temperature, wind), the physico-chemical properties of the contaminant (e.g., boiling point, vapour pressure) or reactivity under the conditions (reaction with atmospheric moisture, oxidation, hydrolysis, etc.). Very important is the time required for realization of self-decontamination and the fact not threaten the lives and environment. Therefore, these mechanisms can be used as a complementary or supplementary method of decontamination. For illustration, some natural ways of decontamination:

- The half-life period as nuclear decay of the radionuclide, after which the activity drops to half,
- Evaporating liquids (liquid pair) and subsequent dilution in the atmosphere to a safe concentration,
- Ultraviolet lights which can cause degradation of hazardous substance molecule,
- Hydrolysis (reaction with water), the product of which is a no dangerous substance,
- Dilution with water, which can reduce the harmful effects.

Physical decontamination methods consist from the fact that hazardous substance is removed from the surface but remains in the waste water after decontamination. These include:

- Adsorption - hazardous substance molecules are trapped on the surface of the adsorbent material -for examples those substances with a large surface, e.g. activated carbon filters in respirators; this principle use different decontamination composition whose active ingredient is a surfactant, decontamination or powders which are used for decontamination of skin,
- Dissolution - substances are dissolve in substances with similar chemical structure or by means of surface tension reducing substances (surfactants); among the hydrophilic compound (water-soluble) include e.g., inorganic salts, ethanol, inorganic acid or base, sarin; lipophilic substances (soluble in fats) are gasoline, diesel, oils,
- Evaporation - change from liquid state in gas,
- Sublimation - solid state change in the gas,
- Mechanical removal – e.g. manual scraping mechanical impurities from the surface (dirt, grease, etc.).

Chemical methods for decontamination remove hazardous substance from the decontaminated surface by chemical degradation or decomposition - by change of the contaminant molecular structure the harmless substance arises.

In other words, reaction of the contaminant with decontamination agent result in a product that is not hazardous. The most commonly represented by the above reactions are as follows:

- a) Oxidation - within decontamination strong oxidizing agents are applying, which include e.g. sodium hypochlorite or peroxide compounds,
- b) Hydrolysis - reaction of a substance with water; an example of hydrolysis is e.g. sucrose reaction in acidic medium within arise of glucose and fructose,
- c) Neutralization - reaction of acid with a base, whose products are salt and water.

2.2 CERTAIN TYPES OF DECONTAMINATION

Emergency decontamination

Emergency or urgent decontamination is the elimination of individuals' contamination whose lives are endangered and it is carried out with or without formally established corridor

for decontamination. Emergency decontamination may include elements of conventional stripping of contaminated clothing, wash up of people with special water from showers or water lines. In determining the location of decontamination wind direction and topography shall be taken into account. In case of terrorist attacks a check for secondary devices around the scene should always be done. Emergency decontamination may be needed for both victims and first responders. First responders may become contaminated before they understand what the actual situation is. In these cases they must withdraw immediately by removing their clothes and pass through emergency decontamination.

These first responders after decontamination should be isolated until it is ensured that they are fully decontaminated.

Decontamination of responders

Rescuers carry out the following activities: assessment of the scene, search and rescue, triage of victims; liquidation of accidents and their consequences. As a result of these actions rescuers can be contaminated but decontamination of the rescuers should be a separate process of the decontamination of the population.

Decontamination is performed in cases of danger to life, health, property or the environment arising from the nature of dangerous substances and to help prevent its spread. Policies, procedures and operations necessary measures for decontamination are listed in the methodical sheets, respectively model activities. Decontamination is done by intervening firefighters, the people affected by dangerous substances or material means and techniques.

For decontamination of intervening rescuers and material resources after returning from the danger zone the decontamination area is designed. In addition, the decontamination area is used for storing protective equipment after decontamination and discarding contaminated equipment and their isolation in airtight containers. It is located on the windward side of the border between dangerous and outer zone with the exception of radiation events when establishing security on the border and the outer zone. If decontamination is necessary, the decontamination area is only possible space for the output from the danger zone, respectively security zone through contamination by radioactive substances.

Custom decontamination work is divided into space for storing material resources, applying decontamination mixture and its flushing, contamination control, removing personal protective equipment and place for re-equipping. Decontamination must be provided no later than before the first firefighters into the danger zone.

Decontamination activities should be done very carefully and honestly to avoid contamination of forces and means.

Mass decontamination

Mass decontamination is the simultaneously holding of general decontamination of many people.

It can be done with or without decontamination corridor and usually involves removal of clothing. Individual removal of contamination can be done by thoroughly wash with water through a line of low water pressure or other water source.

Clinical decontamination

Clinical decontamination is the process in which contaminated victims are handled individually by trained professionals / attendants, doctors / using special decontamination equipment. This type of decontamination is a major, full decontamination process of people because of their medical / health / situation it is impossible to be subjected to mass decontamination without being supported by other people / rescue /. For maximum

effectiveness of decontamination it is recommended that patients are divided into two groups: ambulatory and non-ambulatory patients.

2.3 DECONTAMINATION PROCEDURES AND GENERAL REQUIREMENTS

1. Taking the victims out of polluted areas
 2. Immediate wash of the body with plenty of water
 3. Fast removal of the victims' clothes
 4. The victims transfer for medical first aid
 5. Teams information for emergency and hospitals for hazards
- The location of the point of decontamination should be outside the scope of pollution, but as close as possible to the hot zone.
 - All measures to prevent accidental discharge of polluted water have to be taken.
 - Posts should be properly illuminated.
 - Decontamination corridor has to be created before starting work in the hot zone.
 - Personal belongings and valuables should be placed in sealed packages and marked.
 - Deco corridor should be separate through the barriers, safety cones and other recognizable signalling.
 - First responders working on decontamination **must be protected**.
 - The Incidents with hazardous substances are considered as criminal. All actions that emergency staff takes could physically alter the scene and evidence.
 - Termination of decontamination is associated with the assessment activities and subsequent medical examinations and monitoring.

Whereas decontamination material cannot be available on the site of events, for routine decontamination the ordinary material from equipment of units can be used. Decontamination is divided into following types according the way of performing:

- a) Simplified decontamination is carried out by conventional material resources within unit's equipment, which are solid film of 4x4 m dimensions, B hose, manifold to create a bund, means for applying decontamination mixtures (bucket, broom or sprayer), C hose with a nozzle with a fragmented supply for rinsing and airtight containers for contaminated waste and used material.
- b) Essential decontamination is carried out by special equipment for decontamination (e.g. a decontamination shower, sump tray) with service.

Before applying decontamination mixture it is necessary to remove coarse impurities (e.g. mud from the soles). Then the decontamination is performed successively from top to bottom always in one direction. Within decontamination of PPE it is necessary to pay attention to the part where is the highest probability of contamination: gloves, shoe soles, glasses, pressurized space valves, sites under the arms and in the groin, zippers or clothes that are not connected with each other. Decontamination deposited mixture is allowed to act (exposure time depends on used decontamination composition and contaminant). Showering in subsequent decontamination shower, which should be very intense and should last min. 30 sec. with a continuous rotation so as the entire surface of the garment to be perfectly washed, mustn't be underestimated.

Place for removing personal protective equipment is provided with a bench on the ground with plastic sheet with a textile sorbent. Undress operation must respect the principle not to touch outer parts of the garment. Protective clothing including inside gloves is stored in an airtight container.

Also other material that cannot be decontaminated on the spot should be stored in airtight containers and resalable packaging (plastic barrels) which subsequently will also be decontaminated. After finishing this activity it is necessary to ensure the safe disposal of the decontamination workplace.

Conclusion

Within Chemical, Biological, Radiological and Nuclear emergencies scene it is not possible to design or engineer controls to minimize the spread of contamination but understanding the type and nature of chemical, biological and developing response protection is main step in reducing the impact of an incident.

The CBRN emergency consequences may stretch national capabilities to their maximum extent. Responsibility for the first response remains with individual nations. It is essential that nations build on their resources to respond and mitigate the consequences of an emergency situation to lives, property, and the environment. Numerous response agencies worldwide continue to work to provide accurate, current information to help prepare these on-scene responders.

Literature

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