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CBRN DECONTAMINATION CONSIDERED BY THE CONCEPT OF CBRN SECURITY: A SERBIAN CASE

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Abstract. *Nuclear and chemical accidents lead to endangering the health of citizens and the environment due to contamination by radiological and chemical contaminants and consequently cause security risks for the population and material goods. Decontamination related to CBRN (chemical, biological, radiological, nuclear) events represents a set of processes and activities aimed at total or partial removal or neutralization of radiological, chemical, and biological contamination caused by an intended or non-intended threat, thereby reducing the risk of exposure to the people or the environment up to the permissible levels. The primary and ultimate goal of decontamination is the complete elimination of radioactive contaminants or the minimization of contamination levels of chemical and biological contaminants. The aim of this paper is to demonstrate the relevance of CBRN decontamination observed from multiple perspectives: the environmental resources protection standpoint, the society wellbeing standpoint, and the operative personnel and experience-knowledge standpoint to engage them in the most effective manner.*

Key words: *CBRN decontamination, processes, procedures*

1. HISTORICAL BACKGROUND

Human society has always been exposed to various harmful influences from the environment. However, with the increase in the number of inhabitants and technical installations, the incidence of unwanted events with harmful consequences for human health and the quality of the environment has increased.

Emergency events and accidents related to the discharge of CBRN contaminants in the working and living environment have a significant impact on the quality of the environment, material assets and natural resources, as well as human health. In addition to immediate harmful effects, there are also long-lasting consequences of CBRN accidents that degrade the environment over an extended period of time [1].

CBRN events include all occurrences of a sudden and uncontrolled release of CBRN contaminants. They are treated as deliberate or unintentional events and are most often the result of:

- human factors (misuse, technical - technological flaws, deliberate malicious acts ...),
- nature factors (impact of extreme natural processes - earthquakes, fires, tsunamis, volcano eruptions...).

A nuclear accident is mainly caused by damage to nuclear reactors and other objects containing nuclear assets, resulting in the emission of radioactive material into the environment that threatens the different environmental media (air, soil, water, biodiversity...), material goods, and people's lives [2]. This type of event has relatively low incidence but relatively significant and long - lasting consequences. Decontamination in the occurrence of such an event is the most complex and time - demanding process [3]. Among other, typical compounds that can lead to the radiological contamination of the people, living environment or material assets are isotopes of uranium, radium, caesium, potassium, iodine, carbon, cobalt, strontium, iridium, plutonium, lead, niclel, etc. Regarding the nature of ionizing radiation, these particles can damage human tissue or modify DNA, thereby posing a significant threat to public health.

A chemical accident represents an unexpected event in which chemical contaminants are released, which occurs suddenly and poses a danger to humans, material assets, or the living environment. This type of event has a relatively high frequency and a relatively high impact on the environment and human wellbeing. Decontamination in the occurrence of such an event is a moderately complex process [4]. Among other, typical compounds that can lead to the chemical contamination are organic contaminants like pesticides, pharmaceuticals, composite petroleum, nanomaterials (and other persistent organic compounds) and inorganic like nitrogen, phosphorus and potassium compounds.

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A biological accident is considered to be an unexpected event in which the release of biological contaminants results in a danger to humans or the environment. In this case, there is no threat to material goods. This type of event has a relatively low frequency and relatively low impact on the environment. Decontamination in the occurrence of such an accident is the least complex with regard to different environmental media while the decontamination of the space in which people live is a moderately complex process [5]. Among other, typical compounds that can lead to the biological contamination are bacteria, viruses, yeasts, molds, parasites and their biological products (biological particles with active irritant or toxic effects).

2. COPING WITH CBRN HAZARDS

When considering the concept of CBRN security, it is necessary to take into account the spatial and temporal determinants of it in a wider sense. It is necessary to take into account the fact that the capacity of the responders reaction to a CBRN events can be interpreted differently in space and time. Spatially, it is necessary to take into account whether the environment and social assets are considered as separate entities or as a single system regarding CBRN decontamination. The time-scale response capacity for a CBRN events has its:

- short-term component – absorptive/coping capacity,
- mid-term component – restorative capacity, and
- long-term component – adaptive capacity, as shown in Figure 1.

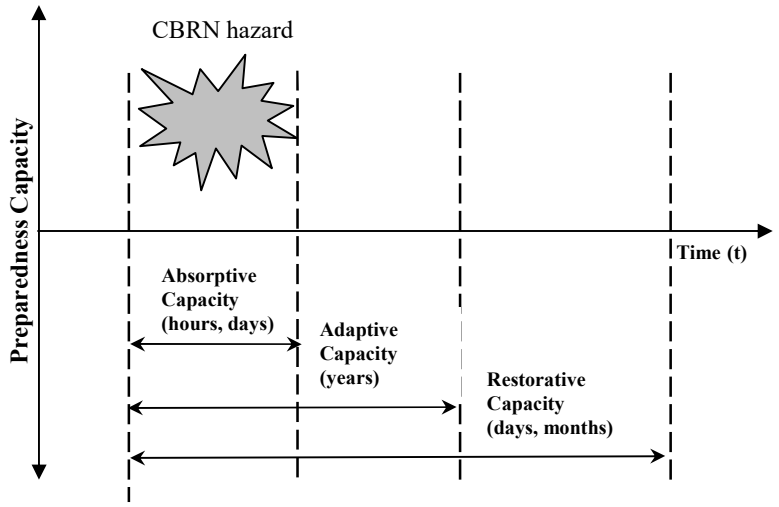

Figure 1. Time-scaled society capacity coping with CBRN hazard (made by the authors)

Functionally observed, the CBRN response capacity can be analyzed as the ability of the system to achieve the desired goals either in regular or emergency situations. As a special component, the preparedness capacity, i.e., the capacity of the responders to prepare for an unwanted event (CBRN accident) which has not yet happened, is also considered [6].

3. KEY ACTORS

The key factor in the process of system management and control is the information exchange between different stakeholders or actors. Fig. 2 represents the holistic conceptual framework of key stakeholders in the process of efficient CBRN decontamination management (Government bodies, Radiation Protection and Nuclear Safety Agency, Environmental Protection Agency, Armed forces, institutes related to CBRN issues, industrial facilities connected to the decontamination processes and procedures, Public utility companies and the Municipal Committee for Emergency Management, etc.) and information exchange among them [7,8,9,10,11,12].

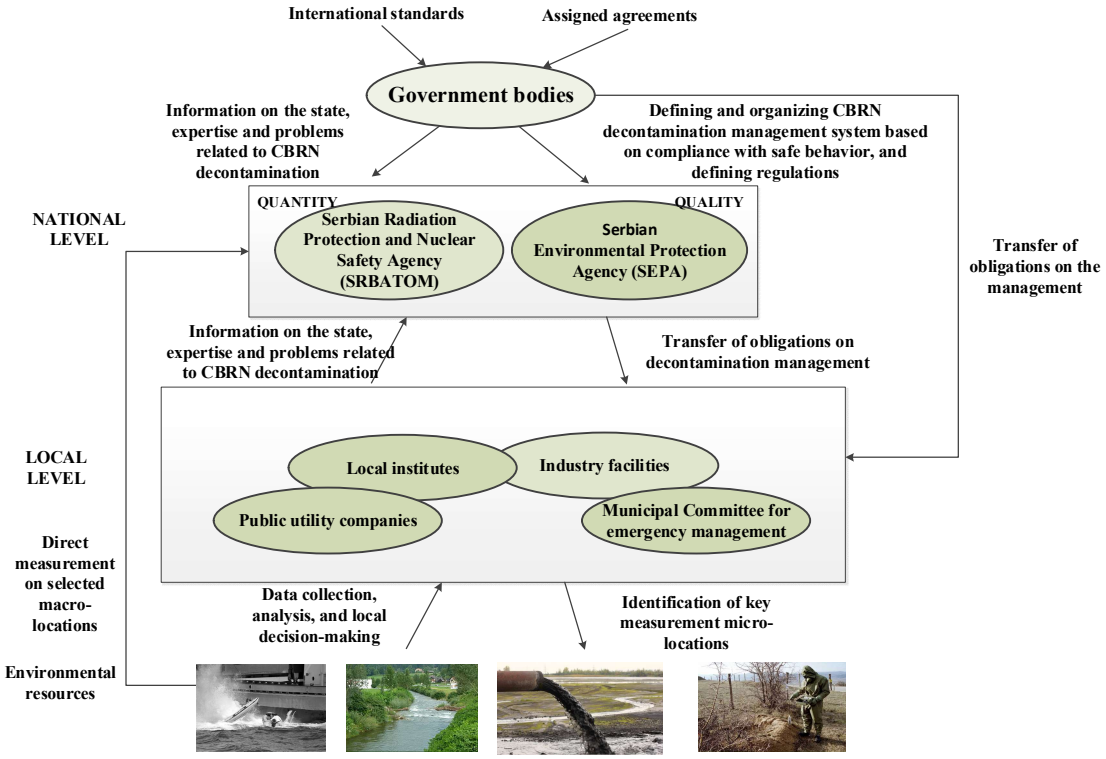

Figure 2. Conceptual framework for CBRN decontamination procedures at a national and local scale (made by the authors)

The management system is hierarchically organized from the national to the local level. At the national level, a regulatory framework for governance is defined. It is determined by the government and adopted by the national assembly. The management aspects that they present are mapped to specific field activities, determined by time and space scales for the monitoring of CBRN hazards. The main goal is to enable the desired level of environmental quality at the local level to be achieved. Therefore, it is important to establish coordination and collaboration between different stakeholders in the governance system, exchange information between different hierarchical levels, and make effective decisions based on available information. It is an encouraging fact that a similar way of preparedness, mitigation, response, recovery, and adaptation to CBRN accidents can be found in the positive legislative acts of surrounding countries [13].

4. DECONTAMINATION TYPES

The meaning of decontamination mainly refers to the removal of dangerous substances – contaminants (chemical origin), radioactive contaminants (radiological origin), or biological contaminants (biological origin) from environmental media, material assets, or individuals. Decontamination related to the CBRN events represents a set of processes and activities aimed at total or partial removal of radiological, chemical, and biological contamination caused by an intended or non-intended threat, thereby reducing the contamination of the people or the environment up to the permissible levels. The process of CBRN decontamination is applied to humans, animals, technical means, material assets, clothing and equipment, environmental media, and buildings.

The CBRN decontamination process involves a set of measures and activities performed in order to remove CBRN contaminants released during CBRN events, which reduces the hazard level in contaminated environments to acceptable contamination levels. The ultimate goal of the CBRN decontamination process is the complete removal of radioactive contaminants, chemical, and biological contaminants.

With respect to the scale of performed activities and achieved effects, CBRN decontamination can be either complete or partial. A partial chemical of biological decontamination process involves the removal of the outer layers of clothing. This can significantly reduce the contamination level, especially in the case of biological or chemical agents.

Complete CBRN decontamination of people is performed by the CBRN units in designated facilities (decontamination stations). The decontamination of environmental media and material assets is performed by CBRN field units [3].

5. Conclusion

The concept of CBRN security in the narrow sense refers to a degree of protection in terms of preserving the nation, individuals, material assets or environment from certain CBRN hazards, damages, or crimes. The concept of CBRN security should always be considered in interconnection with similar concepts such as safety, continuity, and reliability. The key difference between the concept of CBRN security and the concept of CBRN safety is that when studying the concept of security, the actions of people deliberately trying to cause the destruction of certain goods must also be taken into account. In this sense, CBRN decontamination procedures should be observed as an immediate responder's option.

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