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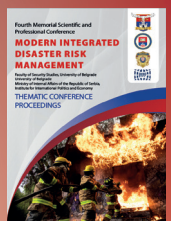

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Review article

Organization of Emergency Response and Rescue Units in Emergencies Caused by Hazardous Materials

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Abstract

Industry has become inconceivable without the use of various hazardous materials in production processes. They are an inevitable companion of modern times, and science and technology further accelerate their development. The system of protection and rescue in emergencies caused by hazardous materials depends on knowledge of the characteristics of a large number of hazardous substances, which, during production, storage, distribution, transportation, and use, may cause serious consequences for people, property, and the environment. In addition to understanding their characteristics, it is necessary to examine their harmful effects and the technical and technological processes involved. Radioactive, explosive, flammable, toxic substances, and biological agents, by their very nature, represent hazardous materials and can easily be misused for malicious purposes, including terrorist attacks. The effective mitigation of consequences arising from such dis-

asters largely depends on management and cooperation among emergency response and rescue units at the scene. No single emergency response unit can provide an adequate response on its own, relying solely on its own resources and capacities. Therefore, it is necessary to establish an organizational structure and management system capable of adequately responding to the situation. Based on domestic and international scientific literature, and using content analysis, the author will, in the introductory section, familiarize readers with the concepts and characteristics of hazardous materials, followed by rescue activities and the interdependence of emergency response services. In the final part, the operational and tactical levels of the management system for disasters caused by hazardous materials will be examined (the strategic level of management will not be addressed), using the "8-step" procedure.

Keywords

Hazardous materials; protection and rescue system; emergency; emergency response and rescue units; "8-step procedure".

1. Introduction

Hazardous substances and their harmful effects can cause major problems during production, transportation, processing, storage, and use. A large number of hazardous materials used in everyday life can be misused for terrorist purposes. Accordingly, it is necessary to undertake appropriate measures at the operational, tactical, and strategic levels. These measures include training and equipping emergency response and rescue services to enable effective intervention. Management of disasters caused by hazardous materials is highly complex, as it requires coordinated activities of all emergency response units within the shortest possible time, while ensuring the safety of all participants and the efficiency of consequence mitigation. Such situations demand that leaders be well prepared for highly stressful and complex tasks. Trained members of the police, fire, and rescue units, and emergency medical services must arrive at the scene as quickly as possible. Leaders and personnel of emergency response units must be aware that such situations can occur at any time and in any place. Personnel must be familiar with the characteristics of hazardous materials and be able to recognize when an incident involves a terrorist act. Effective management of emergencies caused by hazardous materials depends on the existence of response plans, the level of personnel training, and the use of specialized command structures (Cvetković, 2020).

Given the characteristics of such emergencies, all emergency response and rescue services share common objectives, as stated by Mlađan and Cvetković (2012, p. 535): saving and protecting human lives; alleviating suffering; controlling the emergency; warning the public and businesses, providing advice and information; protecting the health and safety of emergency response personnel; preserving the environment; protecting property (assets) as much as possible; maintaining or restoring critical activities; and sustaining normal services at an appropriate level, etc. In examining the organization of emergency response and rescue units in hazardous materials incidents, particular attention should be paid to studies on first responders' capacities, inter-agency coordination, institutional organization, industrial hazards, and the role of technology in disaster response. Research on first responders emphasizes the importance of strengthening operational capacities, preparedness, and resilience in order to ensure an effective response to complex emergencies (Cvetković, 2025). Closely related to this, studies on the collaboration between volunteer and professional fire units highlight the importance of interoperability, role differentiation, and coordinated action among rescue services (Molnár, 2024). The relevance of hazardous-material incidents is also supported by work focusing on hazardous chemical handling industries, where continuity planning and structured preparedness are essential for reducing response gaps and organizational failures (Kumar, 2024). In addition, broader analyses of industrial disasters underline the need for a holistic understanding of causes, consequences, and resilience-building mechanisms in technologically driven emergencies (Cvetković, Renner, & Jakovljević, 2024). From an organizational perspective, studies on disaster response coordination, network structures, and decentralized disaster management systems further demonstrate that effective emergency response depends on clear command arrangements, institutional integration, and cooperation across multiple actors (Masaba, Aryatwijuka, Ntayi, & Bagire, 2025; Mokhele, 2024; Ocal & Torun, 2025; Pandya, 2025). Finally, research on emerging and new technologies in disaster management shows that technological innovation can significantly improve situational awareness, communication, coordination, and operational efficiency during emergency interventions (Hanspal & Behera, 2024; Jovičić, Gostimirović, & Milašinović, 2024). Taken together, these references support the argument that the successful organization of emergency response and rescue units in hazardous materials emergencies depends on preparedness, coordination, institutional clarity, and technological support.

In emergencies caused by terrorist acts, reliance on established procedures ensures consistency in tactical operations, regardless of which emergency response and rescue services are involved (Cvetković, 2013a). Defining and implementing key steps in establishing an organizational structure

can significantly facilitate the work of emergency response units (Cvetković, 2014, p. 64; Kramer, 2009, p. 74). Studies on integrated disaster risk reduction systems, disaster response roles, critical infrastructure protection, fire protection, and psychosocial support in emergencies can support the organization of emergency response and rescue units for hazardous materials incidents. Milenković (2025) is particularly relevant because it examines the theoretical, institutional, and organizational aspects of an integrated disaster risk reduction system, which directly relates to structuring response units and defining responsibilities in complex emergencies. Popović Mančević (2025) is also useful because it analyzes the role of military actors in natural disaster response, offering broader insights into multi-actor emergency organization and support functions. Miletic and Stojanović (2025) contribute indirectly by addressing risks and threats to critical infrastructure, which is highly relevant since hazardous materials incidents often endanger key infrastructure systems. Jovanović Popović (2025) provides an additional connection through the topic of fire protection, which is closely associated with hazardous materials emergencies due to the frequent presence of flammable, explosive, or chemically reactive substances. Finally, Janković et al. (2025) broaden the perspective by emphasizing the role of psychosocial support in emergency and disaster management, reminding us that effective rescue organizations also include support functions beyond purely technical intervention.

The organizational structure must be established by the emergency service that first arrives at the scene and maintained so that, upon the arrival of additional services and units, effective coordination of all currently and subsequently available resources can be achieved, along with the necessary instructions for participants. It is essential to establish a unified organizational framework across key services and, depending on the nature of the emergency, to designate the lead service. A unified command post should be established. Any lapse in safety may result in casualties. Basic strategic objectives and priorities must be defined. Focus should be placed on patient triage, locating and identifying all victims, and establishing a priority system for treatment and transport. Control over victims, facilities, and responsible services must be carried out in a unified manner using standardized methods. No single service can effectively manage an emergency independently; therefore, training programs should be implemented at regional and broader levels. Organizational procedures and control mechanisms must be respected not only in emergencies but also in everyday operations (Cvetković, 2014, p. 64; FEMA, 2004, p. 29).

The eight-step procedure itself provides a flexible tactical management system that ensures consistent management structures regardless of the type of hazardous material involved. Essentially, eight fundamental steps must

be undertaken, typically following the timeline of a terrorist emergency. As stated by Cvetković (2013a), these steps include: incident management and control of the affected area; problem identification; hazard and risk assessment; selection of protective clothing and equipment; management of information and response resources; implementation of response strategies; decontamination and cleanup operations; and termination of the emergency.

According to the Emergency Response Guidebook (Vodič za odgovor na udes, 2024), hazardous materials are defined as substances which, during production, transportation, processing, storage, or use in technological processes, release or generate infectious, irritating, flammable, explosive, corrosive, asphyxiating, toxic, or other hazardous dusts, fumes, gases, mists, vapors, or fibers, as well as harmful radiation in quantities that may endanger human life and health, material assets, and the environment at varying distances from the facilities in which they are present. As noted by Cvetković (2012), hazardous materials can be classified into the following categories according to international classification standards: class 1 – explosive substances; class 2 – gases under pressure, liquefied gases, or gases dissolved under pressure; class 3 – flammable liquids; class 4 – flammable solids; class 5 – oxidizing substances; class 6 – toxic (poisonous) and infectious substances; class 7 – radioactive materials; class 8 – corrosive substances; and class 9 – miscellaneous hazardous materials.

2. Organization of rescue activities and interdependence of emergency response services

Mitigation of the consequences of emergencies involving hazardous materials depends on cooperation and coordination among emergency response and rescue services, given that their competencies overlap and complement one another. The adoption of appropriate laws and by-laws, which would serve as a fundamental basis for the development of adequate procedures, would enable the integration of responsibilities among multiple rescue services (Cvetković, Filipović, & Gačić, 2019; Cvetković, 2012).

As noted by Cvetković (2022), in emergencies involving hazardous materials, the organization of rescue operations depends on several factors: (a) the type of hazardous materials; (b) the manner of their use and release; (c) the affected area; (d) the number of people present; (e) the infrastructure; and (f) the level of equipment and availability of protective resources.

At the very beginning of organizing protection and rescue activities, it is necessary to conduct chemical reconnaissance in order to determine the type and concentration of hazardous substances, as well as the boundaries and dynamics of the contamination zone, the dimensions and characteristics

of the affected facility, the level of contamination, the quality of the terrain and air, and the least contaminated access routes to the site. Identifying the source of contamination is the initial phase of chemical reconnaissance. A comprehensive inspection of each room must be carried out, as well as of the surrounding area, territory, and community within the contaminated zone. Other responsibilities of chemical reconnaissance units include delineating the boundaries of contaminated zones, identifying and marking routes, determining deployment and assembly directions for response forces, enabling evacuation without exposure to contamination, and preventing further incidents (Cvetković, 2022; Cvetković, Popović, & Sadiah, 2014).

The most commonly used methods for recognizing and identifying hazardous materials include: (1) the location and extent of their effects; (2) the types and shapes of containers in which hazardous materials are stored; (3) labels and color codes; (4) hazard identification lists; (5) transport documentation; (6) detection instruments; and (7) symptoms of resulting illnesses. In addition to the above, special attention must be paid to preventing the spread of contamination and maintaining control of the affected site. Contaminated or exposed personnel must be isolated to prevent contamination from spreading beyond the controlled area. Therefore, reconnaissance is conducted first in order to assess the scale of the problem in such disasters (Cvetković, 2022).

Previous experience indicates that upon the arrival of emergency response and rescue units at the incident site, it is crucial to determine the physical extent of the emergency in order to avoid worsening the existing safety situation. Furthermore, emergencies of this type must be properly managed in their initial stage, as it becomes increasingly difficult to control the situation as it evolves. Effective and safe mitigation of harmful effects requires establishing control over the site itself (Cvetković, 2022).

Controlling the incident site itself is critical, as it significantly influences the development of tactics and the overall response to the situation. In mitigating the consequences of an emergency, the police, alongside fire and rescue units and emergency medical services, play a significant role. Police officers are typically the first to arrive at the scene. Such situations require the establishment of three cordons: an inner cordon, an outer cordon, and a traffic control cordon. Accordingly, the incident site is divided into three zones: the exclusion zone, the restricted access zone, and the safe zone (Cvetković, 2020; Cvetković, 2022).

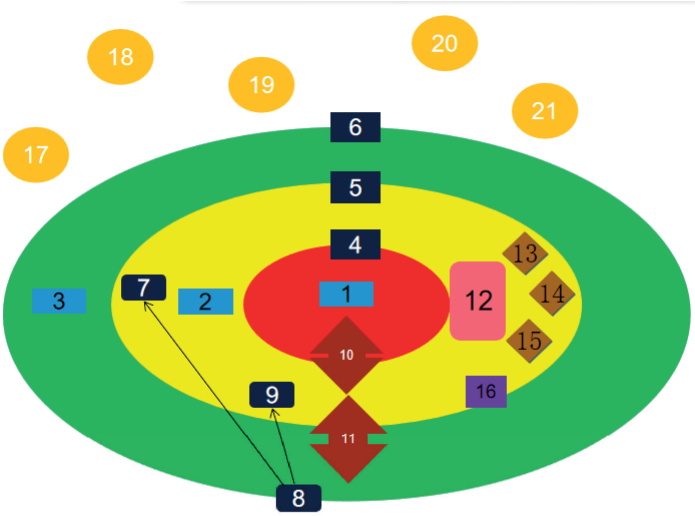

Figure 1. Organization of an incident site affected by an emergency involving hazardous materials and adapted from (Cvetković, 2022, p. 92).

forbidden zone (hot zone); 2. restricted access zone (warm zone); 3. safe zone (cold zone); 4. internal cordon; 5. outer cordon; 6. traffic cordon; 7. operational headquarters (joint control center); 8. control of access to the place of emergency; 9. assembly place; 10. control point of access to the internal cordon; 11. control point of access to the external cordon; 12. police district; 13th place for the media; 14. central bureau for victims; 15. place for decontamination; 16th place for logistics; 17. reception center for reception of friends and relatives; 18. reception center for survivors; 19. recreation center; 20. center for humanitarian aid; 21. mortuary.

The restrictive zone (red zone) represents the area surrounding the incident scene, extending far enough to prevent the harmful effects of the action (for police officers, it is the most dangerous contaminated part of the inner cordon). Access to the restricted zone is provided exclusively by emergency and rescue units equipped with special equipment. This zone has one entrance and one exit for access control, to prevent entry without personal protective equipment. It is marked with red and white tapes. Members of the intervention and rescue units deployed at the entry and exit points must know who is allowed to access the inner cordon. Personnel of emergency and rescue services entering this zone must be recorded, so that, in the event of an emergency evacuation from that area, their movements and positions are known. The area of the prohibited zone may become the responsibility of the fire-rescue unit that cooperates with the emergency medical service. Given the limited availability of personal protective equipment, it is necessary

to carry out planned replacements for police officers. After the end of the rescue phase, the police will take responsibility and transfer the deceased and mortal remains, perform a forensic examination, and collect evidence. The restricted access zone adjoins the restricted access zone, which represents a space where there is no harmful pollution from hazardous substances for people, but equipment and people leaving the restricted zone can be contaminated. Within the restricted access zone are an operational headquarters, a meeting place, a police area, decontamination centers, and the injured (Cvetković, 2022).

It is usual to set up three cordons in such situations. An internal cordon is placed around the restricted zone to ensure immediate security. The outer cordon closes a wide area around the inner cordon and thus provides a restricted access zone. To prevent unauthorized vehicle access to the area affected by the disaster, a traffic cordon is set up outside the outer cordon. The personnel who make up the external cordon must be warned of the possibility of unauthorized people attempting to gain access. This is especially true for remote sectors of the border area. Decontamination of people and equipment is carried out in this zone. Police in this zone control the crowd and provide aid and decontamination according to priorities. The outer cordon provides a limited access zone. The basic function of this cordon is to create conditions for a safe working environment for intervention and rescue units responding to a disaster (Cvetković, 2022).

An area with no pollution is a safe zone. It can be divided into two subzones. The first sub-zone is the area where the equipment and resources of all participating intervention-rescue units are located. The second subzone is part of the traffic cordon and refers to preventing access by unauthorized vehicles. In this subzone, there is also a space for the media (Cvetković, 2014; Cvetković, 2022).

All members of intervention and rescue units should be directed to a single gathering point. The meeting place should be safe and secure. The operational headquarters is the central location where the leaders of the intervention and rescue units make joint decisions on disaster management. The access control center must be under police control, clearly visible, and placed outside the outer cordon. It keeps records of all personnel of non-intervention services who requested access. After the check, the personnel are escorted to the meeting place or operational headquarters. The central authorities establish the holiday center, which is a gathering place for evacuees. These centers are open for up to 48 hours and staffed by medical personnel. These centers provide food, communication, and security. The reception center for survivors serves to identify and document survivors. Police officers carry this out. A reception center for friends and relatives opens at a

safe distance from the disaster site. Depending on the availability, it opens within 12 hours after the disaster. Friends and relatives can come here to get information about missing persons and victims. The local community should establish a Center for Humanitarian Aid within 48 hours after the disaster. This center assists persons directly or indirectly threatened by such a disaster (Cvetković, 2022).

No single emergency response and rescue unit can, on its own, using only its own capacities and resources, provide an adequate response to mitigate the consequences. Therefore, it is necessary to establish a management system that will adequately address all needs at the incident site (Cvetković, 2020; Cvetković & Miladinović, 2018).

3. Levels of management and the application of the operational and tactical levels of work organization, known as the eight-step procedure

The management of rescue operations implies a process that includes: collecting data on the status and progress of rescue operations; analyzing and assessing the situation and the course of rescue activities; preparing conclusions and proposals regarding the composition of emergency response and rescue services and the procedures for their deployment; communicating tasks to subordinate command structures; organizing the interaction of operational units; and ensuring the support of their activities (Cvetković, 2022, p. 80; Voronoi et al., 1995).

In emergencies, the initial response comes from emergency response and rescue units. In the initial stage of an emergency for which no prior warning was issued, the operational level of management is activated first. If there is a threat of further deterioration of the situation, the command is then escalated to a higher level of management, the tactical or strategic level (Cvetković, 2022; Đurđević, 2016).

According to Cvetković (2022:446; Cvetković, 2013), the operational level of management is the level at which work is carried out in the emergency area or its surrounding areas, and it represents day-to-day response to immediate lower-level hazards. Emergency response and rescue units involved in mitigating the consequences undertake appropriate measures and assess the scope of the problem. They retain full control over the resources and means they use within their area of responsibility. The operational-level commander directs resources toward specific tasks within their domain of responsibility and acts in accordance with prescribed duties until another command level is established. This level of management is appropriate for

the effective coordination and resolution of multiple immediate, small-scale hazards. A key role of the commander at this level is to decide whether circumstances warrant activating the tactical level of management.

If the commander of the operational level of management in emergencies involving hazardous materials assesses, or circumstances indicate, that this level of management cannot provide an effective response, the system transitions to the tactical level of management to ensure the execution of all activities and to provide a comprehensive response. At the tactical level of management, significantly more equipment, rescuers, and personnel trained for specific emergencies are deployed to implement protective and rescue measures in hazardous-material emergencies. Tactical-level commanders carry out priority actions, assign tasks, allocate resources, and make decisions regarding further activities. They are obliged to comply with occupational safety and health requirements and to implement appropriate measures to reduce risk. At all times, they must be aware of what is occurring at the operational level (Cvetković, 2012; Cvetković, 2019; Cvetković, 2022). One of the most serious security threats is an emergency caused by the use of hazardous materials for terrorist purposes (Bošković & Cvetković, 2017; Cvetković, 2012b, p. 58). Setting aside the strategic level of management, in such emergencies, the operational and tactical levels of work organization are applied, commonly known as the eight-step procedure.

In the following section, each step will be explained.

3.1. Management and control of the area

In this step, it is necessary to (Cvetković, 2012b, p. 58): approach the location of the emergency and position emergency response and rescue services; establish control and activate the emergency management system (the first arriving emergency response unit activates the management system); coordinate other emergency response and rescue services; define danger zones (inner, outer, and traffic cordons; if the emergency area is not isolated, security will be compromised); and implement all measures aimed at protecting the population (evacuation or sheltering procedures). The objective of area management is to rapidly establish control over the emergency site and separate people from the incident, which is further assessed and evaluated in the next step. Management and control of the area are achieved by forming cordons.

3.2. Problem identification

The subject of identification is based on the recognition, identification, classification, and verification of hazardous materials (Cvetković, 2014; Thomas, 2008). Actions are carried out as follows: detection of the presence of hazardous materials; identification of the hazardous materials involved; if precise identification is not possible, an attempt is made to classify and determine the type of hazard (e.g., corrosive substance, toxic gas, etc.); upon arrival at the scene, any initially obtained information must always be confirmed. The initial information should never be assumed to be accurate without verification. Common methods for recognizing and identifying hazardous materials include (Cvetković, 2014; Paulun, 2003): the location and extent of the incident; the shape of containers in which substances are stored; markings and colors; placards, labels, and hazard lists; transport and other documentation; detection and measurement instruments; sensory indicators; symptoms of exposure and resulting illnesses, etc.

3.3. Risk and hazard evaluation

At this stage, absolutely no poor assessments must be made. During the risk assessment phase, it is necessary to determine both offensive and defensive measures to be taken and the tactical procedures to be applied at the incident site. In this context, hazard refers to a threat that may endanger human life. In emergencies, these elements are treated as constant; they do not vary by incident location and can be obtained from sources such as the Emergency Response Guidebook or material safety data sheets. Risk refers to the likelihood of suffering consequences or losses. Risks associated with hazardous materials are intangible variables that vary from incident to incident and must be assessed by qualified personnel (Cvetković, 2014). According to Heyer, factors influencing the level of risk include (Heyer, 2006): the type of hazard and the quantity of the material involved; the effects of exposure, including the scale of the incident, the size and degree of chemical contamination that may endanger responders, civilians, land, and the environment; and the availability of resources.

3.4. Selection of personal protective clothing and equipment

Personal protective equipment (PPE) refers to any clothing or device worn by emergency response and rescue personnel to protect them from hazards at the incident site. Protective measures for these personnel may vary depending on the tasks to be performed and the specific location of the emergency, and may change in accordance with on-site activities. PPE must

be considered a top priority. Protective equipment directly depends on the physical and chemical properties of the hazardous materials present at the scene. It is of primary importance that personnel involved in the intervention are equipped with appropriate protective clothing and adequate equipment for the expected tasks. When selecting protective clothing, the type of hazardous material must be taken into account, as well as the response strategy to be implemented. Protective suits will vary depending on several factors, most commonly according to the task, i.e., whether police officers will perform offensive or defensive operations, or carry out certain measures and actions in the absence of direct intervention (Cvetković, 2014, p. 68; Law Enforcement Officers Guide, 2003:51).

3.5. Control of information flow and coordination of resources

Control of information flow and coordination of resources refer to the process of determining the timely and effective management, coordination, and dissemination of all available data, information, and resources among all stakeholders (National Fire Protection Association, 1994). The effectiveness of coordination is directly related to the implementation of the emergency management system and its procedures. If the elements of command established at the incident site are not properly implemented, it will be very difficult for all personnel present at the scene to operate safely and effectively (Cvetković, 2014). The basic guidelines to be considered include (Cashman, 2008): confirming emergency orders and monitoring developments to ensure that they are properly received and executed; maintaining strict control of the situation; ensuring continuous progress toward resolving the problem within the established timeframe, and requesting additional assistance without delay in case of escalation; ensuring that all key actors understand the action plan and the decision-making process; recognizing that bad news does not improve with time; and preventing external factors from interfering with the unified command structure.

3.6. Implementation of priority actions

During the implementation phase, emergency response and rescue services operate in accordance with the adopted strategies governing this field. Specific tasks include (Cvetković, 2013a, p. 59): initial entry to the site and continuous monitoring in order to determine the current level of danger; assessment of the incident scene to identify evidence that may be used in reconstructing the event; identification of factors that caused the emergency;

interviewing personnel present at the scene and witnesses to establish obtained information and opinions formed based on available data; and documentation of preliminary findings. In essence, when such an emergency occurs, the incident commander may choose one of three models (Combs, 2003, p. 76): the offensive model (attack model), which aims to direct resources toward suppressing the spread of harmful effects of hazardous materials; the defensive model (protection model), which directs resources (personnel, equipment, and materials) toward less aggressive objectives. The defensive approach may require marking certain areas as closed and contaminated. At the same time, the response focuses on limiting further effects of the hazardous substance, and the non-intervention model, which implies no action is taken. The basic principle of non-intervention is that authorities allow the emergency to follow its natural course until the risk of intervention is reduced to an acceptable level (Cvetković, 2014, p. 69).

3.7. Decontamination and terrain cleaning

Decontamination is a process in which equipment, personnel, and supplies are freed from the influence of hazardous materials present during entry into or work within contaminated areas. At the incident site, decontamination must be carried out to ensure the safety of emergency response and rescue services and the public by reducing contamination on individuals, equipment, and in the environment. Decontamination itself must be coordinated with tactical police operations and properly established. In emergencies, decontamination should be integral to every response plan. Its implementation on a large number of people represents a significant challenge for emergency response personnel. One of the most important decontamination methods is removing clothing. Removing outer garments eliminates up to 80% of contaminating substances (Bellany, 2007, p. 101). On the other hand, washing with water for approximately three minutes also provides highly effective removal of contaminants and must be carried out promptly. In certain cases, decontamination of clothing may be complex, requiring disposal of contaminated items. Decontamination is performed by fire and rescue services or other designated agencies assigned to this task. Decontamination aims to enhance and ensure safety at the emergency site by minimizing the potential for secondary contamination outside the incident area. The decontamination zone is usually located within the restricted access area, preferably upwind of the incident site, and must be clearly marked and identified. Decontamination methods can be divided into physical and chemical methods (Cvetković, 2014). According to Carus (2002), physical methods include brushing and scraping, dilution, absorption, heating, and the use of low or

high air pressure (pressurized air may cause contaminants to detach from surfaces and pose inhalation and further spread risks). Chemical methods include chemical degradation, neutralization, solidification, disinfection, and sterilization.

3.8. Termination of the emergency

In the phase of terminating the emergency, command is transferred to the appropriate service responsible for coordination and activities following the emergency. Emergency response and rescue services must check their personnel and equipment, conduct an investigation related to the emergency, and transfer command to the lead service responsible for post-incident operations. According to Levy (2010), activities undertaken after the completion of an emergency situation can be divided into three groups: submission of the incident report, analysis of the emergency, and critique of the emergency. In the final phase of termination, or after the personnel of these services are released, an emergency report is submitted. The submission of the emergency report is most effective when a designated individual is appointed to lead it. Such a report should be concise, covering only the main aspects of the emergency, and should not exceed 30 minutes. Recommended topics include (Cvetković, 2013a, p. 51): health information; issues requiring immediate action (procedure failures, major personnel problems, and legal involvement in recovery operations); and highlighting correctly performed activities as well as recognition from the incident commander for well-executed work. The objectives of the report should include (Cvetković, 2012c, p. 105): informing emergency response personnel about possible exposure to toxic substances and associated signs and symptoms; identifying equipment failures requiring immediate attention or isolation for further analysis; defining responsibilities for data collection for the analysis and critique of the emergency; summarizing the actions taken by each department or sector within the emergency management system; and emphasizing positive aspects of the emergency response. The analysis should focus on five relevant areas: the emergency management system; tactical operations; plans and planning; support services; and resource availability. The purpose of the critique is to identify deficiencies in the management system, rather than to find faults with the personnel involved. Completing the operational critique improves performance and planning by increasing efficiency in addressing identified shortcomings (Cvetković, 2014).

4. Conclusions

The number of hazardous materials is increasing alongside the development of science and technology in industry. As the bearer of overall environmental security, the state assumes responsibility in this area. One of the key security risks is hazardous materials, which can daily endanger large numbers of people, the environment, and property during their production, storage, distribution, transport, and use worldwide, as well as through their potential use in the form of chemical, biological, radiological, and nuclear weapons, or in terrorist acts (Đurđević, 2016; Cvetković & Filipović, 2018).

The protection and rescue system must be adequately prepared, organized, equipped, and trained to prevent such emergencies and provide a rapid, efficient response. It is clear that, in addition to significant resources for ensuring appropriate equipment for working with hazardous materials, the basis of successful preparedness lies in the awareness of the existence of real large-scale threats and the competence of all actors within the security system, as well as other participants present at the scene of hazardous material incidents (Đurđević, 2024; Cvetković, 2018; Cvetković & Milašinović, 2017; Cvetković et al, 2019).

In the future, members of emergency response and rescue units responsible for responding to hazardous material incidents will be repeatedly put to the test. Modern technologies pose increasing challenges for the readiness and training of all emergency personnel to respond to terrorist attacks adequately. The use of highly dangerous substances as weapons for terrorist purposes further complicates the actions of responders in such emergencies (Đurđević, 2016).

All of the above indicate the need to improve and develop all competent emergency response and rescue units as one of the fundamental pillars of security in the Republic of Serbia. Competent emergency services must be prepared to respond to incidents involving hazardous materials that create emergencies and crises. Procedural activities of emergency services involved in responding to hazardous material incidents must be further developed, all members of the operational structure must be trained, and they must be adequately equipped to operate in such conditions. The seriousness of a country in preparing for responses to terrorist attacks involving hazardous materials is reflected in the adoption of national plans and procedures addressing this type of threat. Responsible planning authorities should timely develop and adopt plans and procedures for coordinated and individual action of all emergency services. In addition, continuous, regular, and frequent testing of the functionality of adopted plans and procedures is essential (Cvetković & Mlađović, 2015; Đurđević, 2016).

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