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EMERGENCIES WITH HAZARDOUS CHEMICALS AND RESPONDING TO THEM

Abstract. The territory of Ukraine is full of dangerous chemical facilities, accidents at which can cause emergencies of a technogenic and military nature. Damage to such facilities can lead to the release of hazardous chemicals. In addition, during the war, Russia purposefully uses special ammunition loaded with hazardous chemicals. The primary task of responding to such events is to quickly identify the substances and determine the type of threat, possible hazards and scale.

Keywords: emergency, hazardous chemical, threat, response

The constant development of technologies, the increase in the types and volumes of production and use of hazardous chemicals substances (HCS) affects the formation of threats to the occurrence of emergency. The main types of chemical threats are the transportation of HCS, their industrial use, military conflicts and terrorism.

Today, Ukraine, on the territory of which an armed conflict is ongoing, has the highest risks of chemical hazards among the countries of the European region.

The territory of Ukraine are saturated with dangerous chemical facilities, accidents and disasters at which can cause emergencies of a technogenic and military nature with a scale that can be equated to the consequences of the use of weapons of mass destruction.

Industrial infrastructure can carry significant risks of chemical accidents and emergencies. In Ukraine, the war has led to a rapid increase in the number and frequency of such emergencies, significantly increasing these risks and making them less predictable. Shelling or missile strikes near industrial, nuclear, and chemical facilities across the country increase the level of threats to human life and health, also lead to long-term negative consequences for the environment. Damage to toxic waste and pesticide storage facilities, ammonia pipelines, water treatment plants, and petrochemical facilities can lead to releases of hazardous substances.

A threat to chemical safety is the presence of factors or situations that arise during the production, transportation, storage, and use of chemical products, including the risks of chemical incidents, sabotage, terrorist acts, and emergencies, and lead to increased risks to the environment and/or human health [1, 2].

Chemical emergencies can occur in various scenarios, including accidents at industrial plants and transport infrastructure, and the use of chemical weapons by an aggressor. Such incidents often accompanied by the release of hazardous chemicals into the environment. Among the most dangerous are chlorine, ammonia, hydrocyanic acid, phosgene, sulfur dioxide and other compounds that can quickly spread in the atmosphere and cause large-scale pollution.

Emergencies with hazardous chemicals result in the release of hazardous substances into the environment, the consequences of which require an urgent response to contain the release (spill), protect people and the environment.

First-priority response measures for hazardous chemicals substances emergency include: recognizing a HCS event, determining the nature and type of threat, identifying HCS, and assessing risks. The ability to recognize an event involving

hazardous substances is the key to correct and effective actions and decisions at the initial stage of the occurrence and development of an accident. The primary task is to quickly identify hazardous chemicals substances and determine the type of threat, possible hazards, and scale. Identifying the danger zone, isolating it, and evacuating it will help to avoid an increase in the number of victims and establish control over the situation.

When an event identified as HCS event, it is necessary to determine the extent of the consequences - the number of victims and the necessary medical and sanitary measures. Providing medical care to victims in areas of chemical contamination is one of the key elements of the overall emergency response system. Decontamination is the process of carrying out medical and sanitary measures to remove chemical agents from the surface of the human body that may pose a risk to public health [3, 4]. Decontamination carried out outside the contaminated area.

An incident involving the use of chemical warfare agents will be much more dangerous and will have significant consequences compared to an industrial accident with hazardous chemicals substances. Timely recognition of such an incident can save hundreds of lives. At first, it will have similar initial signs of industrial hazardous chemicals substances emissions. The attention should be paid to the availability of information about the threat of a terrorist attack, detected objects similar to improvised explosive devices, and the presence of used protective equipment.

A zone of possible damage is a separate territory in which, as the result of an emergency or dangerous event, there is a threat to the life or health of people and damage to property [1].

Initial response to a hazardous chemicals substances release emergency involves zoning the scene. The area immediately surrounding the HCS release (outflow) is a hot zone (Figure 1). It requires immediate evacuation of victims and the public. Personal protective equipment must comply with the highest protection class for the specific substance. The area with reduced pollution called the warm zone. The

contamination-free zone called the cold zone. No special personal protective equipment used in it.

place of event

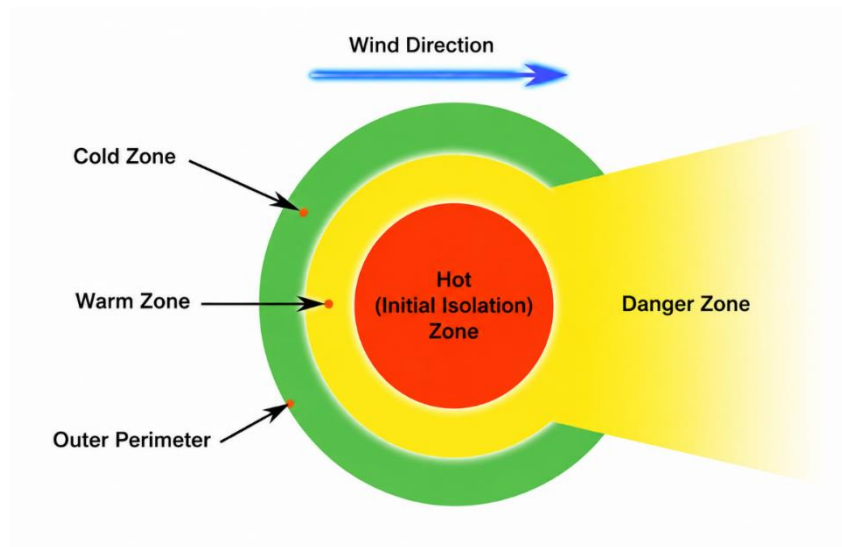


Fig. 1. Zoning of the scene

Detailed calculation of the predicted chemical pollution zone is performed using the "Forecasting Methodology" [5]. The methodology allows for a long-term (operational) and emergency assessment of the situation in the event of accidents associated with the spill (emission) of hazardous substances from technological tanks at chemically hazardous facilities, automobile, river, railway (while stationary) and pipeline transport [6, p. 137].

For unknown substances, or for mixed substances (for example, in the case of a road accident), the initial danger zone is 50 m for bulk materials, 100 m for liquids (from the spill site), and 300 m for gases.

According to the General Staff of the Armed Forces of Ukraine, during the entire period of the Russian Federation's war against Ukraine, almost 12 thousand cases of the use of dangerous chemical substances were documented [7]. In 2025, the russians, along with traditional means of fire, regularly used special ammunition equipped with irritating chemical substances. These include, in particular, gas

grenades of the K-51 and RG-VO types, equipped with CS and CN substances. In total, 6540 cases of the use of dangerous chemicals recorded during 2025.

According to the Chemical Weapons Convention [8], the use of such substances as a means of warfare is illegal, their use in combat conditions poses a threat to the life and health of military personnel and is a direct violation of international norms.

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