PRECAUTIONARY MEASURES FOR HIGH-RISK FACILITIES: NEW CHALLENGES AND STRATEGIES

Levchenko O. G., doc. of tech. sc., prof., Head of Department of Labor Protection, Industrial and Civil Safety of Igor Sikorsky Kyiv Polytechnic Institute;
Polukarov Yu. O., Ph.D., Ass. Prof., Zemlyanska O. V., Senior lecturer (Dep. LPICS of Igor Sikorsky Kyiv Polytechnic Institute)

Abstract. In modern conditions, the importance of preventive measures at high-risk facilities is increasing due to the rising number of man-made and natural threats. A key component of ensuring safety is the implementation of modern methods and strategies to minimize the risk of emergencies. This paper addresses the main challenges faced by high-risk facilities and proposes new risk management approaches to protect employees, the public, and the environment. The presented solutions are based on innovative technologies, enhanced personnel training, and optimization of safety control systems at such facilities.

Keywords: technological hazards, high-risk facilities, safety control, protection of personnel and the public, environmental safety.

Анотація. У сучасних умовах зростає значення запобіжних заходів на об’єктах підвищеної небезпеки через збільшення кількості техногенних та природних загроз. Важливою складовою забезпечення безпеки є впровадження сучасних методів і стратегій для мінімізації ризиків виникнення надзвичайних ситуацій. У даній роботі розглядаються основні виклики, з якими стикаються небезпечні об’єкти, та запропоновано нові підходи до управління ризиками, які сприяють захисту працівників, населення та довкілля. Представлені рішення базуються на інноваційних технологіях, підвищенні кваліфікації персоналу та оптимізації систем контролю безпеки на таких об’єктах.

Ключові слова: техногенні загрози, об’єкти підвищеної небезпеки, контроль безпеки, захист персоналу та населення, екологічна безпека.

Introduction. The modern environmental and population threats in Ukraine, caused by russia's military aggression, lead to emergencies, fires, and hazardous events that demand increased attention, effective preventive measures, and responsive actions to ensure the safety of people and territories.

Analysis of the state of the issue. A high-risk facility is one where the use of hazardous substances, execution of high-risk technological processes, and presence of specialized equipment create dangers not only for employees but also for nearby populations. In the event of an accident, the environmental damage can be significant, even catastrophic. These facilities are assigned a specific hazard class after undergoing identification procedures and require strengthened, specialized measures to prevent emergencies.

The increased risk to the population and surrounding areas necessitates enhanced measures to prevent emergencies at high-risk facilities. During martial law, special attention is given to the safety of nuclear power plants (NPPs), which are

classified as both high-risk facilities and critical infrastructure. Ensuring their safety is of paramount importance at both national and international levels [1].

The purpose of the work. Analyse the main risks at high-risk facilities in modern conditions and suggest ways to minimize them.

Methods, materials and research results. The system of regulatory, legal, organizational, and technical measures that govern safety at high-risk facilities contributes to their operational stability and minimizes risks in both peacetime and wartime. In times of conflict, it is crucial to address additional military threats that may impact the safe operation of these facilities to prevent emergencies.

Ensuring the safety of high-risk facilities has become a priority during armed conflict, particularly regarding the nuclear safety of NPPs, which have become targets of military pressure and potential attacks [2]. During repeated russian assaults on Ukraine's energy infrastructure, power units at various NPPs have been forced to shut down on multiple occasions [3]:

- Khmelnytskyi NPP: In February 2023, one reactor was shut down due to instability in the power grid caused by Russian attacks on infrastructure.
- Zaporizhzhia NPP: On March 9, 2023, following missile strikes, the last connection to the Ukrainian power system was severed, leaving the plant completely without power, which could have led to an accident with global-scale radiation consequences.
- Rivne NPP: During a massive missile and drone attack in August 2024, three units at Rivne NPP automatically disconnected from the power grid for safety reasons, causing significant power outages across Ukraine.
- South Ukraine NPP: During the August 2024 attack, the plant reduced its output and later disconnected one unit due to fluctuations in the power grid caused by the shelling.

These incidents underscore the dangers that regular russian attacks pose to the stable operation of NPPs, increasing the risk of accidents with potentially catastrophic consequences for Ukraine and the world.

Preventing emergencies at high-risk facilities is a critically important task at the state level. This is achieved by planning and implementing a range of preventive measures and tools. If an emergency does occur, every effort should be made to minimize its impact as much as possible. According to the Law of Ukraine “On High-Risk Facilities” [4], a corresponding register of such facilities exists, and their condition is subject to thorough state monitoring. Under this law, oversight at the state level for high-risk facilities is entrusted to authorized central executive bodies and their regional agencies.

It is worth noting that the identification of high-risk facilities is carried out by the business entities that own at least one potentially hazardous facility. Entities planning to build such facilities are also required to ensure the identification procedure for high-risk facilities.

A crucial role in ensuring safety at high-risk facilities is played by the safety management system. This includes measures and direct actions by the operator to minimize the risk of emergencies at such facilities. The safety management system

also includes:

- establishing a set of requirements for working personnel;
- improving the control and management system for changes in safety measures;
- analysing all potential risks at these facilities;
- thoroughly monitoring the safety measures executed by the personnel;
- developing contingency and emergency response plans in case prevention efforts fail. This plan will help contain the spread of consequences and minimize the number of affected individuals through the prompt response of specialized units and teams.

The implementation of these measures and their effectiveness largely depend on personnel training in emergency response. Business owners must organize scheduled training and drills on response algorithms for situations involving:

- radiation and chemical exposure;
- shelling from various types of weaponry;
- technological fires.

Special attention should be paid to providing medical aid skills.

These measures should ideally be implemented using all available modern resources:

- posting posters and boards displaying action algorithms for various situations;
- broadcasting informational and educational videos on special monitors;
- distributing relevant instructions and methodological materials to employees.

Given the potential risks at high-risk facilities, it is extremely important to have modern protective structures where personnel can stay until emergencies are contained and mitigated. This means that these protective structures should be equipped with a supply of food, drinking water, medicine, and essential items. In addition, the protective structures should have ventilation and sewage systems.

Conclusions. In summary, it can be concluded that safety measures at high-risk facilities in today's context should include a comprehensive set of actions and resources:

- developing plans for containing and mitigating the consequences of accidents, considering all potential risks specific to the facility;
- collaborating with occupational health and civil protection specialists;
- implementing modern information and alert systems;
- developing an evacuation algorithm;
- introducing early detection systems for emergencies;
- conducting training with practical exercises on providing first aid and responding to emergency situations.

In addition, it is important to promote strict adherence to all safety requirements, which will foster a sense of responsibility among personnel for their own and collective safety.

References

1. Бойко О. Об’єкти підвищеної небезпеки: упровадження вдосконалених підходів до їх ідентифікації // Науковий вісник: Цивільний захист та пожежна безпека. – 2023. – №. 1 (15). – С. 83-91. https://doi.org/10.33269/nvcz.2023.1(15).83-91.

2. Several Nuclear Power Units in Ukraine Disconnected During Massive Russian Attack on Monday. Kyiv Post. Ukraine’s Global Voice. August 30, 2024. URL: https://www.kyivpost.com/post/38215.

3. Олексій Павлиш. Обстріли РФ енергоінфраструктури призвели до зупинки одного з блоків Хмельницької АЕС. Українська правда. 10 лютого 2023. URL: https://www.pravda.com.ua/eng/news/2023/02/10.

4. Про об’єкти підвищеної небезпеки: Закон України від 18 січня 2001 р. № 2245-III (поточна редакція – 01.01.2024). URL: https://zakon.rada.gov.ua/laws/show/2245-14#Text.