

PRACTICAL ASPECTS OF SAFETY IN DEALING WITH MAJOR INDUSTRIAL ACCIDENTS

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Abstract: *The article presents issues concerning selected elements in the field of organising and conducting practical exercises to prepare rescue entities and teams of upper-tier establishments for major industrial accidents in the aspects of formal and legal requirements for the managers of an establishment, the authorities of the State Fire Service in the context of the tasks performed in relation to the needs of the society. In this respect, a review was made of European Union and national legal acts relating to selected preparatory elements of the system for preventing major industrial accidents and the requirements for the operators of upper-tier establishments and the organs of the State Fire Service in the event of a major industrial accident. Moreover, on the basis of practical participation in the exercises, the course of various forms of practical exercises related to the consolidation of principles of proceeding in case of an emergency situation was evaluated. The topics were based on new legal regulations in the field of environmental law and the requirements to be met by practical exercises preparing services and company teams to limit and eliminate hazards.*

Keywords: high-risk facility, practical exercises, emergency plan.

INTRODUCTION

Nowadays, it is possible to list a wide range of hazards that constantly affect public and occupational safety. The development of areas such as industry and transport, in addition to positive civilizational changes, has brought a corresponding increase in the occurrence of risks to people (Steumpfle, Howells, Armour, & Boulet, 1996). As a result of incidents that have occurred in plants using dangerous substances, posing a risk to people and the environment, legal regulations have been enacted in various countries regarding safety in industrial plants and the safety of surrounding local communities (Michalik, 2005). The most important of these regulations is the Seveso III Directive—Directive 2012/18/EU of the European Parliament and of the Council of 4 July 2012 on the control of major-accident hazards involving dangerous substances, which amended and subsequently repealed Council Directive 96/82/EC (Directive 2012/18/EU, 2012). This directive was implemented into Polish law in the Act of 27 April 2001, the Environmental Protection Law (Act of 27 April 2001 on Environmental Protection Law, 2001).

Taking into account the element of preparedness for a major industrial accident, the obligations of the Member States of the European Union under Article 12(6) of the Directive include ensuring that internal and external emergency plans are reviewed, tested, and where necessary, updated by the operators and designated authorities at suitable intervals of no longer than three years (Directive 2012/18/EU, 2012). The review shall take into account changes occurring within the establishment or safety services concerned, the latest technical knowledge, and knowledge concerning the response to major accidents (Kołcz, 2023a).

In view of the above, the research problem addressed in this article is the performance of tasks related to drills by upper-tier establishments operating under the major-accident prevention system. This implies the need to determine whether the formal-legal requirements indicate the necessity of undertaking practical drills by establishment teams preparing for emergency response in the danger zone. Moreover, it is crucial to assess whether the mechanisms of practical exercises, when they take place, will

minimize the effects of a major accident on people, the environment, and property by preparing forces and resources for a proper response in an emergency situation (Lesiak, & Porowski, 2012).

For the purpose of this paper, theoretical and empirical research was carried out. The paper is based on an analysis of legal acts and literature, as well as direct observation, to specify practical elements that should be implemented by operators in order to improve the system of major-accident prevention (Regulation of the Minister of Internal Affairs...,2016).

LEGAL CONSIDERATIONS FOR SELECTED ELEMENTS IN UPPER-TIER ESTABLISHMENTS FOR THE PREVENTION OF MAJOR INDUSTRIAL ACCIDENTS

Pursuant to Art. 261. item 3 of the Environmental Protection Act, the operator of an upper-tier establishment is obliged to analyse and practice the internal emergency plan at least once every 3 years in order to update it and make justified changes to it; in particular, the changes introduced to the installation, the way the fire protection units operate, the state of knowledge concerning preventing, combating and removing the effects of an industrial accident, as well as scientific and technical progress should be taken into account.

In order for the operator to fulfil the above-mentioned statutory requirements concerning practising the procedures for preventing major industrial accidents and implementing the internal emergency plan, after agreeing common time arrangements, a co-operative exercise is planned between the high-risk establishment and the rescue services of the State Fire Service and the entities included in the internal emergency plan.

An analysis and exercise of the internal emergency plan shall be carried out with a view to updating and making any reasonable adjustments to the plan.

The main objectives of the exercise include:

- to consolidate the rules of conduct in the event of an emergency (alerting the State Fire Service, people in the vicinity, other functionaries according to the procedure contained in the internal operational and rescue plan,
- testing the rescue procedures in the event of an industrial emergency (fire, release of a dangerous substance) included in the internal operational and rescue plan,
- perfecting the functioning of the company's management team - testing the skills of the engineering and technical staff,
- Checking the operation of the early warning and notification system, - Checking the efficiency of fire-fighting equipment,
- checking the efficiency of fire-fighting equipment (fire switches, hydrants, hand-held fire-fighting equipment),
- carrying out evacuation of plant employees from the administrative building and production facilities,
- perfecting cooperation with the incoming commander of the State Fire Service and informing the rescue operation commander about possible threats.

In particular, these exercises should take into account the proper organisation of preventive and rescue actions in the context of proper preparation of the engineering and technical staff and employees of the plant to jointly improve the way in which they prepare for and protect themselves against emergency situations in the event of their occurrence by using elements that are decisive for the ability to reduce the level of risk both for employees in their workplaces and through the proper conduct of rescue actions that minimise the effects on people, the environment and material values (European Parliament and Council, 2012).

Further taking into account the task aspect according to Art. 265. para. 9 also the regional commander of the State Fire Service, on the basis of information presented by the operator of an establishment with a high risk, after drawing up an external emergency plan for an area exposed to the effects of an industrial accident, is obliged to analyse and practice the implementation of the external

emergency plan at least once every 3 years, in order to introduce the necessary changes to it; in particular, the changes made to the installation, the way in which the fire protection units operate, the state of knowledge concerning the prevention, combating and elimination of the effects of an industrial accident, as well as scientific and technical progress should be taken into account (Obolewicz-Pietrusiak & Wojnarowski, 2001).

In this respect, the provincial commander of the State Fire Service on the basis of Article 265(9) of the Act of 27 April 2001. Environmental Protection Law, in most cases orders the preparation and carrying out of a practical-application rescue drill on the implementation of selected elements of the external emergency plan for a high-risk establishment (Konieczny, 2001).

The main purpose of the exercise is to test the principles and procedures contained in the external emergency plan for the establishment, in particular regarding:

- 1) the participation of plant personnel and management in notifying and alerting emergency services and external entities of the danger and in undertaking rescue operations and directing these operations until fire protection unit forces and resources arrive on site;
- 2) alerting and evacuating people from the area outside the site of the establishment and notifying establishments and other neighbouring entities in the event of a major industrial accident;
- 3) cooperating with representatives of establishments and neighbouring institutions in taking measures in the event of the impact of a major industrial accident on their areas;
- 4) practical participation of the forces and resources of the CSR, taken into account in the external emergency plan, in liquidation of a simulated hazard arising on the site of an establishment;
- 5) the participation of other emergency services, entities and self-governing bodies foreseen to take action in the event of a hazard involving areas outside the establishment in the event of a major industrial accident.

In this context, the aim may also be to check the state of preparedness of forces and means for conducting the rescue action, in the scope of elimination of hazards by:

- 1) using the tactical and technical capabilities of the equipment and facilities of the fire protection units participating in the exercises,
- 2) perfecting the skills of commanding tactical associations by the command staff of the State Fire Service,
- 3) perfecting the methods of organising the point of reception of forces and means,
- 4) organisation of communication for the needs of conducted rescue actions,
- 5) organisation of action headquarters,
- 6) organisation of logistic and technical facilities for the needs of conducted actions.

The premise of the exercise includes one of the scenarios included in the safety report, the occurrence of which will result in an industrial accident impacting on a site outside the area of the aforementioned establishment.

To this end, the government administration body shall require those responsible for preparing and conducting the exercise to:

- 1) make all arrangements with the management of the above-mentioned establishment and the entities foreseen to participate in the exercise with regard to the detailed conduct of the exercise;
- 2) draw up and submit detailed exercise documentation for approval;
- 3) draw up, together with the management of the abovementioned establishment and the entities participating in the exercise, conclusions resulting from the scope of the exercise in the context of possible changes or corrections to the external emergency plan for the abovementioned establishment.

PRACTICAL GUIDANCE FOR CARRYING OUT EXERCISES IN UPPER-TIER ESTABLISHMENTS AGAINST MAJOR INDUSTRIAL ACCIDENTS

Comparing the above issues, it can be seen that the tasks differ fundamentally in relation to the objective of the exercise. The exercises of the internal emergency plan focus in particular on the actions of mitigation and elimination of the effects of a major industrial accident in relation to the source of danger in a given installation of a plant, performed by engineering and technical personnel, company services and rescue

entities. Therefore, it can be concluded that this aspect is focused on locating the accident as soon as possible and taking appropriate actions to remove the hazard.

It should be emphasised that the external emergency plan exercise is focused on the actions taken outside the plant towards neighbouring institutions and the execution of tasks by rescue entities and services cooperating with the local administration (Michalik, 2005).

In the preparation process of training against major industrial accidents through the use of various forms of exercises, it is observed that not all the assumed objectives are implemented during the exercises. This is often caused by not respecting the time regime assumed in the organisation of exercises. Focusing too extensively on selected elements in application or practical IROP exercises, in particular on the process of noticing the emission of a hazardous substance, detecting and determining the location of its source of emission before the arrival of forces and resources or the very process of taking action by company teams causes that, at a later stage, the exercise takes place, for reasons of time, in a limited scope in relation to elements connected with the performance of tasks by local administration, emergency management bodies and public safety and order services (Kołcz, 2023b).

It is in the emergency management system at the municipal government level that the basic tasks that relate to monitoring, warning, alerting, planning, response and recovery from major emergencies in their area should be practised. These tasks will also relate to evacuation, medical assistance, social assistance, providing the necessary conditions for survival. Analogous tasks should be rehearsed by the districts supported by the composite administration, which are responsible for coordinating activities at district level. The voivodship level should also be involved here, which in turn is responsible for the cooperation of governmental and self-governmental administration bodies, directing their activities in the field of risk prevention, maintenance of public safety and order, prevention of natural disasters and other hazards and combating and removing their effects (Komenda Główna Państwowej Straży Pożarnej, 2021).

Conclusions on the implementation of selected elements of the external emergency plan of a high-risk establishment indicate the main objective of the exercises which is to test the principles and procedures contained in the external emergency plan of the establishment. The exercises should be attended by officers of the State Fire Service and representatives of the Voivodeship Inspectorate of Environmental Protection, the Poviát Inspectorate of Building Control, the crisis management structures of the Poviát Starosty, the Town and Municipality Office and the engineering and technical staff together with plant teams. It should be emphasised that the practical part should involve, among others, the forces and resources of the Specialised Chemical and Ecological Rescue Groups. The indicated mechanisms should minimise the effects of a major accident on people, the environment, property through the preparation of forces and resources, appropriate actions, proper response in an emergency situation (Regulation of the Minister of Internal Affairs..., 2021).

Referring to selected elements of safety against major industrial accidents, empirical research was carried out using a diagnostic survey method with questionnaires among employees of management teams and engineering-technical groups of establishments at high risk of a major industrial accident and rescuers of a specialised chemical-ecological rescue group. The survey used closed questions that required the selection of one or more answers concerning prevention, response and cooperation in an emergency situation. The survey included questions in the form of a questionnaire, two of which were: 'which form of exercises brings the most benefits in terms of acquiring knowledge and practical conduct in the establishment' and "how often is there a need to organise joint exercises with rescue entities in the establishment where you work (Announcement of the Marshal of the Sejm, 2022).

The survey therefore referred to the used form of improvement of their skills by company teams and services and rescue entities. The indications of the respondents in this respect are presented in Fig.1.

On the basis of the respondents' answers, we notice various references to the quality and quantity of the organised exercises of rescue entities and company teams. The first aspect concerns the form of exercises that are preferred by the survey participants. It turns out that, similarly to PSP, ZDR indicate mainly practical exercises with the development of a common assumption (refers to greater interaction between PSP and ZDR) and a theoretical discussion with the specification of conclusions after the practical execution of a given exercise assumption. This aspect was unanimously indicated by 60-70% of the respondents from ZDR and up to 83% from PSP (Komenda Główna Państwowej Straży Pożarnej, n.d.).

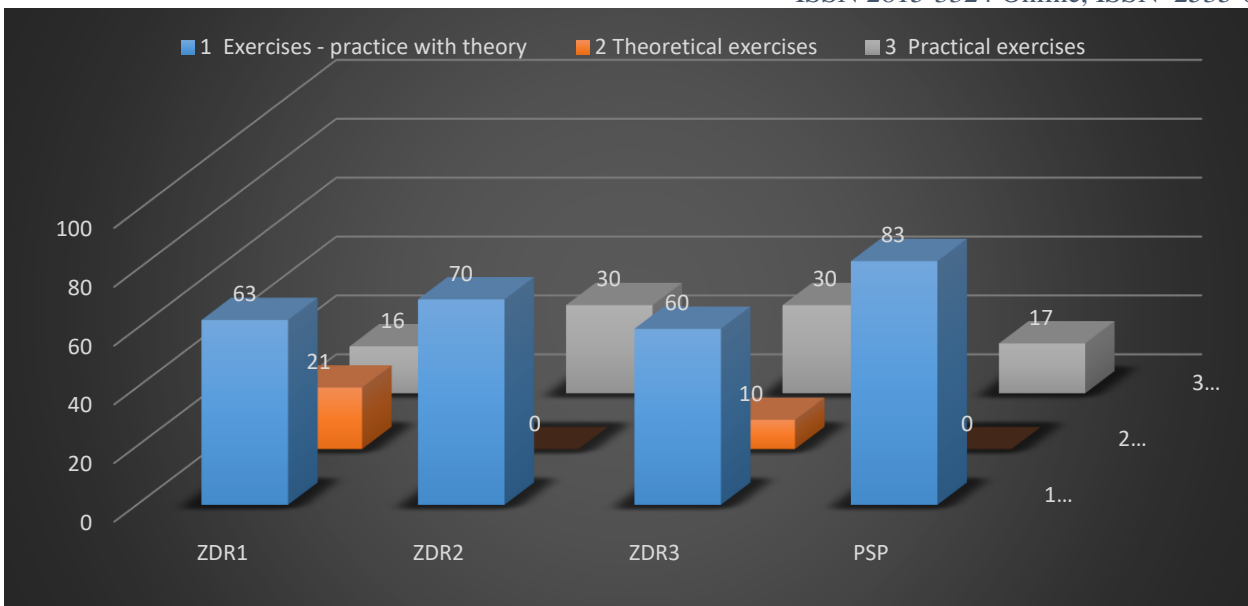
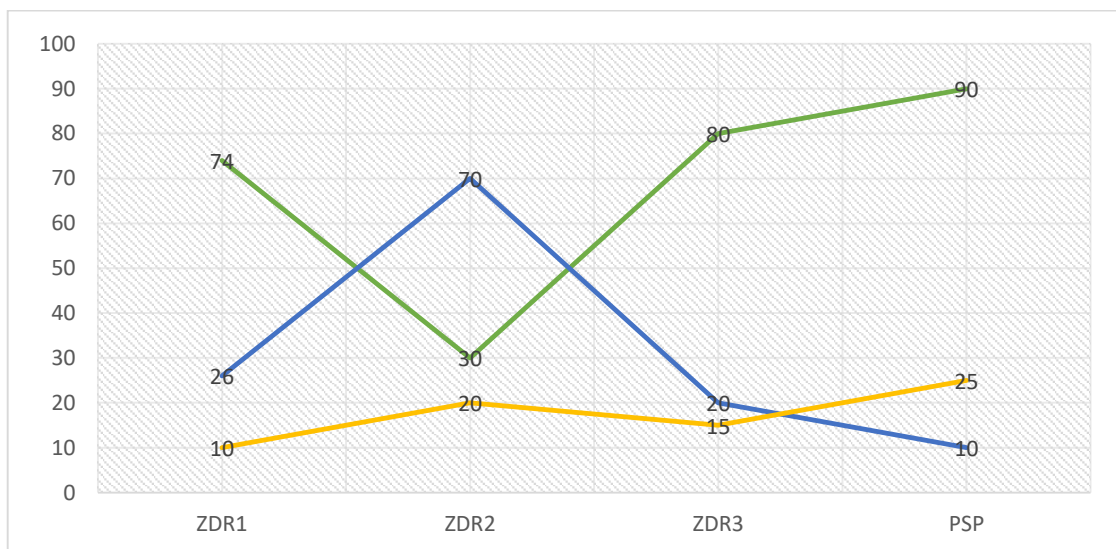


Fig. 1. Percentage distribution of answers to the question 'which form of exercises brings you the most benefits in terms of knowledge acquisition and practical conduct' with respondents answering according to the following designation: 1- Exercises combined practical development with theoretical discussion of an assumption and presentation of conclusions; 2- Exercises within the framework of theoretical familiarisation with the possibilities of the given entities, installations; 3- Practical exercises through joint development of a given assumption.

Source: Own study.

In the second study, we see that most respondents prefer exercises once a year, except for one company that wants to do it twice or even more (Fig. 2). It can be assumed that this process results from the specificity of the company, depending on the number of installations, as well as organizational tasks, conditioned by the time of qualification to high or increased risk.



Legend:

- Exercises twice a year
- Exercises as desired
- Exercises once a year

Fig. 2. Percentage distribution of responses to the question: "how often does the company you work in need of organizing exercises in cooperation with rescue entities?" Source: own study.

Since the exercises were assigned by the legislator to be performed at least once a year, in connection with the above, the survey of respondents also indicates that such an amount of training of plant teams and rescue entities is acceptable. However, the essence is the quality of these exercises, the goals we want to achieve and the effectiveness associated with the familiarity of the exercisers with the equipment, facility or terrain, the consolidation of habits while maintaining the degree of difficulty, taking into account the systematicity that determine the effectiveness of this form of training (Skoczek, 2023).

CONCLUSIONS

The scope of practical exercises carried out indicates the formulation of the following observations and conclusions, in the context of making possible changes or updating data in the internal and external operational and rescue plan. A sudden release of a hazardous substance as a result of a failure, caused for example by atmospheric discharge, may create a fire or explosion hazard, and consequently the creation of a toxic gas cloud, which will most likely spread outside the plant premises. Depending on the prevailing weather conditions (wind force and direction, precipitation, atmospheric pressure) and the terrain, neighbouring plants, residential areas and nearby forests and communication routes (road and rail) may be at risk. Therefore, it is very important to test in practice the alarming and notification of the existing threat to services, inspections and guards, as well as those plants, offices, institutions and other entities that will be exposed to the danger associated with the risk of an industrial failure and the effects of which may affect outside the plant. In order to warn plant employees, residents and people staying in the area potentially at risk of the effects of a serious industrial accident, notification and alarm systems operating within plants, as well as within local government units at the municipal and district level, should be maintained in constant readiness and technical efficiency. Early warning systems (manual fire alarms, alarm sirens, stationary and mobile public address points), communication (voice, radio, telephone), mass media (television, radio) and social communicators (internet, text messages, applications, etc.) should be used for this purpose. To this end, the mutual alarm and notification system should be continuously improved in practical exercises, which will minimize the risk of secondary losses for plants, employees staying in the area and people in the vicinity of the plant.

In the event of a serious industrial accident, a "domino effect" may occur, which may result in a series of unforeseen events, occurring one after another and difficult to control, and posing a risk of fire and/or explosion both on the premises of the plant and outside its area, on the premises of neighbouring plants, forest areas, development areas, etc. Therefore, exercises should take into account the most unfavourable scenarios, taking into account the potential effects on people, the environment and property and the range of their impact in the event of leakage and release of a hazardous substance and fire. In the event of a serious industrial accident, cooperation and collaboration of services, inspections, guards, entities and institutions involved in the implementation of rescue operations and other tasks in the scope of limiting and removing the effects of this accident on the plant and outside its premises is very important. For this purpose, the head of the rescue operation should appoint a staff during practical exercises. The staff, including its individual teams, should involve representatives of the services, inspections and guards, crisis management structures, as well as employees of neighbouring plants who have knowledge and experience that constitute a valuable source of expert and specialist knowledge, particularly in terms of knowledge of technological processes, physicochemical properties of substances used in production, installations and devices exposed to failure and damage, and threats and hazards that may occur on the premises of these plants.

During the practical exercises in the scope of managing the evacuation of employees from the danger zone, the person in charge of the plant rescue operations should receive feedback on the number and health condition of the evacuated persons and whether all the persons from the endangered area were evacuated. Information on the course of the operations after the arrival of the first forces and means of fire protection units should be passed on by the employee responsible for managing the rescue operations on the premises to the person in charge of the rescue operation (KDR). It is important that this person remains

in constant contact with the KDR until the rescue operations are completed. For easier identification, this person should be marked (e.g. reflective vest, identification card).

The production activity of plants related to the production of products with a very wide range of applications may pose a risk of a serious accident, due to the use of hazardous substances/mixtures. In such a case, emergency scenarios should be developed for individual installations, together with a definition of the range of their impact in the event of a release, including the zone; toxic/flammable hazard, thermal radiation, overpressure wave. The substances/mixtures listed in the internal operational and rescue plan have safety data sheets that describe, among other things; their physicochemical properties, conditions for their safe use, types of threats they may pose to life, health and the environment, including in the event of a fire. The proper selection and speed of application of the extinguishing agent that will be used in the extinguishing system and by the fire brigade units arriving at the scene of the incident is of great importance for the effectiveness of practical exercises during the simulation of a fire. Due to the potential danger that chemical compounds may pose in production processes, it is necessary to consider equipping plants or organizational units of the State Fire Service with extinguishing agents dedicated to extinguishing a given group of fires. An important task element in the process of maintaining the continuity of extinguishing agent supply in the event of a fire, e.g. of polar liquids on the installation, is to immediately ensure the transport of foaming agent necessary for rescue and firefighting operations. In connection with the above, this element should also be practiced in practice. In such an event, it is important to effectively supply foam streams in order to secure and extinguish the fire and, what is very important, to use the appropriate foaming agent, e.g. AFFF for polar liquid fires resistant to alcohols.

Practical exercises carried out on plant installations containing tanks with various chemical substances show that in the event of an industrial accident (toxic substance leakage and fire), an efficient and effective foam extinguishing system and a plant water supply network are necessary, providing the appropriate amount of extinguishing agent needed to conduct effective rescue and firefighting operations. The existing water supply network should allow for simultaneous supply of extinguishing currents from portable cannons, which in the event of a large fire will ensure sufficient efficiency of the extinguishing agent. Therefore, it seems reasonable to analyze the possibilities of increasing the efficiency of the plant water supply network and its practical testing during exercises in order to maintain the continuity of extinguishing agent supply and achieve effectiveness in action. During exercises, it should also be considered to organize additional water supply, using, for example, fire tanks located on the premises of neighboring plants. Taking into account the above indications, it should be recognized that practical solutions will contribute to improving the process of prevention and preparation for combating serious industrial accidents in high-risk plants. This condition is the proper organization of practical exercises cooperating with the application of evaluation of their course, paying attention to the practical elements that need to be actually practiced, with adherence to time rules, an appropriate number of practical exercises combined with a discussion of conclusions and the selection of appropriate forces and resources.

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