

# IMPLEMENTATION OF INDUSTRIAL ACCIDENT PREVENTION POLICIES BASED ON AN INVESTIGATION OF ACTUAL CONDITIONS IN AN EXPLOSIVES MANUFACTURING PLANT

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**Abstract:** In order to establish principles for implementing requirements contained in legal acts regarding methods of preventing serious industrial accidents, a study of the procedures in place at NITROERG SA, a company manufacturing explosives, was conducted. The analysis also included regulations concerning actions to be taken in the event of an accident, aimed at minimizing negative impacts on people and the environment. Legislative solutions imply the necessity for business entities to submit reports to emergency services, while also carrying out a range of activities to counteract threats associated with serious accidents. This article presents how these recommendations are implemented by the company and the methods of obtaining data to improve the undertaken projects. However, incidents in recent years indicate the need for further verification of processes to eliminate risks.

**Keywords:** serious industrial accidents, safety management, explosives manufacturing, security procedures,

## 1. INTRODUCTION

Environmental safety management in industrial organizations and the protection of the natural environment from the effects of uncontrolled processes occurring during the use of materials, equipment, or installations are regulated by current legislation. For the purposes of this article, an analysis of the actual state of procedures related to prevention and reactive measures at NITROERG SA was conducted. The aim of the study was to identify structural solutions that comply with regulations while being adapted to the needs of an enterprise characterized by a specific level of risk due to the production of explosives and the storage of hazardous chemicals.

## 2. METHODOLOGY

Serious industrial accidents are the subject of research both globally (Şimşek et al., 2024; Monamy and Das, 2024; Rafieyan et al. 2024) and nationally (Borysiewicz et al., 2020; Tępiński and Połec, 2021; Kramarek and Śniegulska-Grądzka, 2018). Scientific reflection



includes the system of counteracting serious industrial accidents and the national firefighting and rescue system (Kołcz, 2024), threat recognition and cooperation of emergency services (Liwo and Gonet, 2020), the aspect of preventing undesirable phenomena in the functioning of a smart city (Kuzior et al., 2023), cooperation with non-governmental organizations (Trocha, 2014), and society (Micińska, 2005). The concept of this study is to analyze the legal framework describing the scope of activities defined by the legislator for a Polish economic entity operating a plant that poses a risk of industrial accidents. Subsequently, an analysis of the actual state at NITROERG SA was performed. The aim was to verify whether and on what principles the procedures prescribed by regulations are implemented to ensure safety by preventing industrial accidents, acts of sabotage, or terrorist attacks. The basic tasks in this area are specified in the Environmental Protection Law of April 27, 2001 (Polish version: Ustawa z dnia 27 kwietnia 2001 roku Prawo ochrony środowiska (Dz. U. z 2001 roku, nr 62, poz. 627). It stipulates that any entity operating a company with increased or high risk, or even one that expresses an intention to operate such a plant, is required to ensure that the facility and installations are designed, built, operated, and then decommissioned in a way that prevents industrial accidents and minimizes their impact on people and the environment. Such an entity must also prepare a safety report, which is required by the Regulation of the Minister of Development of February 23, 2016, on the safety report for a high-risk establishment (Polish version: Rozporządzenie Ministra Rozwoju z dnia 23 lutego 2016 roku w sprawie raportu o bezpieczeństwie zakładu o dużym ryzyku (Dz. U. z 2016 roku, poz. 287).

In terms of planning activities, it is also crucial to develop internal and external operational and rescue plans. The formula for these activities is regulated by the Regulation of the Minister of the Interior and Administration of June 8, 2016, on the requirements for operational and rescue plans (Polish version: Rozporządzenie Ministra Spraw Wewnętrznych i Administracji z dnia 8 czerwca 2016 roku w sprawie wymagań, jakim powinny odpowiadać plany operacyjno-ratownicze (Dz. U. z 2016 roku, poz. 821).

. A strategic legislative tool for enterprise management is also the Regulation of the Minister of Development of January 29, 2016,

on the types and quantities of hazardous substances present in an establishment, which determine the classification of the establishment as one with increased or high risk of a serious industrial accident (Polish version: Rozporządzenie Ministra Rozwoju z dnia 29 stycznia 2016 roku w sprawie rodzajów i ilości znajdujących się w zakładzie substancji niebezpiecznych, decydujących o zaliczeniu zakładu do zakładu o zwiększonym lub dużym ryzyku wystąpienia poważnej awarii przemysłowej (Dz. U. z 2016 roku, poz. 138).

### **3. RESULTS**

The legal analysis indicates that for an economic entity operating a plant at risk of an industrial accident, it is crucial to submit a notification to the State Fire Service, which must include basic information such as the designation of the operator (owner) and the plant manager (administrator), as well as their addresses. Among the identifying parameters is also the company's address (including the website address) and information about the legal title, the nature of the planned or already conducted activity, and the types of installations used with details of the safety systems in place. An important element of the notification to the State Fire Service is also specifying the type and quantity of hazardous

substances used and stored that cause the entity to be classified as an establishment with increased or high risk. These materials must be supplemented with precise physical, chemical, fire, and toxicological characteristics of the described substances. The next point in the notification must be a characterization of the area immediately surrounding the plant, particularly taking into account factors that may contribute to increasing the risk of an industrial accident or aggravating its effects. It is also important to include information about other nearby establishments with increased or high risk, as well as nearby objects that could contribute to intensifying the "domino effect" in the event of an accident. The deadlines for completing these actions are significant for the entities reporting. For new plants or installations, a request must be submitted to the State Fire Service at least 30 days in advance, and if the entity is classified as having "increased risk" or "high risk," the notification must be submitted within no more than one year from the day of classification. Notifications must also be made of any significant changes in the type or quantity of hazardous substances. The Environmental Protection Law requires an establishment with increased or high risk to prepare a program for the prevention of serious industrial accidents. According to the regulations, this program is implemented through a safety management system, ensuring a level of protection for people and the environment appropriate to the threats and considering the specifics of the given enterprise. Article 251 of the mentioned law specifies the requirements for the accident prevention program, which, besides the company's general objectives and operational principles, must include the responsibilities of the plant's management in controlling threats and ensuring the appropriate level of protection, determining the likelihood of an industrial accident, and principles of prevention. The program also involves establishing rules for mitigating the effects of accidents and methods for limiting the scale of their negative consequences. It must also include verification procedures for its relevance and effectiveness, specifying the frequency of such analyses. The prepared document is submitted to the State Fire Service and the regional environmental protection inspector. Depending on needs, the program is subsequently supplemented due to changes in the actual state or advancements in scientific and technical knowledge or findings from other industrial accidents. Regardless of these actions, the entity must analyze the program at least once every five years.

For this article, a review of the planning and organizational activities of NITROERG SA in the safety sphere was conducted. As an explosives manufacturing company, it falls under the discussed regulations due to the use of substances classified as posing: (1) physical hazards (H200, H201, H301, H330, H331, H310, H371, H411) and (2) environmental hazards (NITROCET 50 H302, H312, H332, H411; ammonium nitrate CAS 6484-52-2, anhydrous ammonia CAS 7664-41-7). The company was established based on the plants in Krupski Młyn and Bieruń, the latter of which was launched in 1871, just four years after Alfred Nobel invented dynamite. Both factories have been operating continuously for over 150 years. In 2006, the companies ZTS ERG from Bieruń and NITRON SA from Krupski Młyn were merged to form NITROERG SA (Zdyrko, 2022), with locations in both of these towns.

It was determined that NITROERG SA, classified as a high-risk establishment, obtained an integrated quality and environmental management system certificate, compliant with international standards ISO 9001 and 14001 for the Krupski Młyn location. Additionally, the organizational structures of NITROERG SA include positions of director

representatives for serious accidents and environmental protection, and specialists from various fields continuously assess the safety of processes and installations.

The company has submitted the required notification to the appropriate regional State Fire Service authority, i.e., the Silesian Voivodeship Fire Brigade Commander in Katowice, in the form of a single document for both Bieruń and Krupski Młyn locations. The Accident Prevention Program (PZPA) was also prepared as a single document for both locations. However, the Safety Report (RoB) and Internal Operational-Rescue Plan (WPOR) are separate for each location, meaning two documents were created for these cases. The conducted analyses identified the possibility of five types of serious industrial accidents: (1) explosion, (2) fire, (3) leakage of installations, tanks containing hazardous substances, which can cause contamination of: (a) soil, (b) water, (c) air, (4) destruction of production facilities, and (5) endangering human health and life.

#### **4. DISCUSSION**

The greatest threat to safety and the environment at NITROERG SA is posed by the installations for the production of explosives and blasting agents, as well as the hazardous substances used in technological processes. Among the implemented safety measures are training and courses that enhance the level of professional knowledge and specialized skills. The company has obtained the necessary licenses for the production and trade of explosives and ammunition, as well as positive reviews from the police regarding employees who handle these materials (to prevent sabotage or terrorist attacks). Employees are also regularly subjected to medical, psychotechnical, psychological, and psychiatric examinations.

Basic tasks have been defined for positions at all levels, which are detailed in work and occupational health and safety (OHS) instructions, as well as job cards. Important safety parameters for conducting processes are monitored by both the operating staff, departmental supervision, and technological and OHS services. Additionally, the company conducts systematic inspections of safety levels and the condition of technological installations, and the quality of production meets the requirements of the implemented and certified ISO 9001 system.

The operational plans described earlier in the company include the organization of regular exercises in cooperation with the fire brigade and crisis management services. Practical exercises according to these plans are conducted with the participation of units of the State Fire Service, Volunteer Fire Brigade, local government crisis management services (county and municipal authorities), the police, Emergency Medical Services, and representatives of the State Forests and the Provincial Inspectorate of Environmental Protection. Approximately 150 officers participate in these exercises. A scenario addressing possible failures is prepared each time. For example, it assumes the explosion of explosive material in one of the plant buildings, which causes a shockwave that damages the production line of a substance called nitroset (2-ethylhexyl nitrate used as a diesel fuel additive). The incident is assumed to result in a significant leak of sulfuric and nitric acids, the release of fumes outside, the poisoning and loss of contact with one employee, and a fire in part of the forest surrounding the installation. Similar exercises are conducted at each NITROERG SA plant every three years.

The verification of external operational and rescue plans also involves exercises organized by the State Fire Service, which include analyzing accepted emergency

scenarios, with particular emphasis on areas and facilities located outside the plant's boundaries but within forecasted danger zones.

## 5. CONCLUSION

Despite strict adherence to rigorous procedures and the implementation of additional security systems, serious accidents occur at the studied enterprise. In February 2022, during the technological process of mixing 800 kg of nitroglycerin, an explosion occurred, resulting in the death of two employees. In January 2021, an explosion killed one employee and injured another. Four years earlier, during maintenance work, a detonation caused the death of one employee and injuries to two others. In 2013, an explosion in a warehouse destroyed the building but did not result in any casualties among the employees. These incidents highlight the need for further research into the causes, progression, and circumstances of industrial accidents to update existing regulations.

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The Regulation of the Minister of Development of January 29, 2016, on the types and quantities of hazardous substances present in an establishment, which determine the classification of the establishment as one with increased or high risk of a serious industrial accident. Polish version: Rozporządzenie Ministra Rozwoju z dnia 29 stycznia 2016 roku w sprawie rodzajów i ilości znajdujących się w zakładzie substancji niebezpiecznych, decydujących o zaliczeniu zakładu do zakładu o zwiększonym lub dużym ryzyku wystąpienia poważnej awarii przemysłowej (Dz. U. z 2016 roku, poz. 138).

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