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CHARACTERISTIC OF UPPER-TIER AND LOWER-TIER ESTABLISHMENTS OF MAJOR ACCIDENTS IN POLAND IN COMPARISON TO THE EUROPEAN UNION

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Abstract: The purpose of this publication is to present the characteristics of upper-tier and lower-tier establishments of a major accident, which operate under the provisions of the Seveso III Directive. The article will also present information about the number of these establishments in the EU and Poland. Analysis of the data on the operation of upper-tier and lower-tier establishments of a major accident comparison with the number of major accidents which took place will allow for assessment of the effects of the implementation of the provisions of the Seveso III Directive by EU countries.
Keywords: Seveso III Directive, lower-tier establishments, upper-tier establishments

1. INTRODUCTION

The occurrence of a major accident is often associated with huge losses in the form of human casualties, environmental pollution and material damage. Therefore, everyone's attention should be directed toward measures to prevent this type of situation. Ensuring the safety of citizens, detailed regulation of all issues related to the operation of establishments, where a major accident is possible, is required. In addition, the regulation of major accidents must concern a wide range of people, since industrial accidents can have transboundary consequences, which is why it is so important to have unified regulations that allow a rapid response from all interested parties when such an event occurs.

2. LAW REGULATIONS

The impetus for taking concrete steps toward normalizing regulations for the operation of industrial establishments where there is a risk of a major industrial accident came from the events in Seveso, Italy. It was there in 1976 that one of the biggest industrial disasters in world history took place. As a result of the leakage of 2,3,7,8-tetrachlorodibenzodioxin (a substance known as TCDD) into the atmosphere, the environment was contaminated and a huge number of animals died. The

contamination of the area also affected human health - the symptoms of poisoning were chloral acne (Eskenazi at al., 2018). After this catastrophe, legal action was taken in the European Economic Community, resulting in the adoption of Directive 82/501/EEC of June 24, 1982, known as the Seveso I Directive (OJ L 10, 14.1.1997), which regulated the management of an establishment where hazardous substances are used and the rules to prevent the occurrence of a major accident. The directive was later amended twice. At present, the version in force is Directive 2012/18/EU of July 4, 2012, called Seveso III (OJ L 197, 24.7.2012).

The Scveso III Directive is in line with the policy objectives of the European Union in this area, such as:

- control of major-accident hazards involving dangerous substances;
- limiting the effects in the event of such failures;
- continuous improvement of major accident prevention systems (Direcorate-General for Environment, 2021).

The Seveso III Directive required implementation into the Polish legal system. Provisions related to major industrial accidents were primarily introduced in the Environmental Protection Law of April 27, 2001 (Dz.U. z 2001 r. nr 62, poz. 627). In addition, norms concerning these issues are found in:

- In regulations issued under the Environmental Protection Law:
  - Regulation of the Minister of Development on the types and quantities of hazardous substances present in a establishment, determining the classification of the establishment as an upper-tier establishments or lower-tier establishments of a major accident (Dz. U. z 2016 r. poz.138),
  - Regulation of the Minister of Development of February 23, 2016 on the safety report of an upper-tier establishment (Dz. U. z 2016 r. poz. 287),
  - Regulation of the Minister of Interior and Administration of June 8, 2016 on the requirements to be fulfilled by emergency plans (Dz. U. 2016 r. poz. 821),
  - Regulation of the Minister of Interior and Administration of December 2, 2015 on the detailed scope of information required to be made public by the competent authorities of the State Fire Service(Dz. U. z 2015 r. poz. 2145)
- Acts:
  - Act of October 3, 2008 on the provision of information on the environment and its protection, public participation in environmental protection and environmental impact assessments(Dz. U. 2016 r. poz. 353),
  - Act of July 20, 1991 on the Inspection of Environmental Protection (Dz.U. 1991 nr 77 poz. 335),
  - Act of March 27, 2003 on spatial planning and development (Dz. U. z 2015 r. poz. 199) ;
- and regulation:
  - Regulation of the Minister of the Environment of December 30, 2002 on major accidents subject to notification to the Chief Inspector of Environmental Protection (Dz. U. z 2003 r. Nr 5, poz. 58) ,

With these regulations, the rules for the operation within the European Union of all establishments posing a potential risk of a major industrial accident have been unified.

Upper-tier and lower-tier establishments of a major accident

The classification of Seveso establishments. Based on art.248 paragraph 1 of the Environmental Protection Law, two types of establishments can be distinguished where a major accident is possible:

- Upper-tier establishments of a major accident, referred to as UTP, and
- Lower-tier establishments of a major accident, referred to as LTE.

The criterion, which determines the classification of a given establishment to a specific group, is the type and quantity of hazardous substances present in the establishment. Regulation of the Minister of Development on the types and quantities of hazardous substances present in an establishment, determining the classification of the establishment as an upper-tier establishment or lower-tier establishment of a major accident, specifies the threshold quantities of hazardous substances and the rules determining the category of the establishments.

The inclusion of a given establishment in the category of upper-tier establishments or lower-tier establishments of a major accident takes place when:

- The amount of hazardous substances present at the establishment during normal operation or that may be generated during an industrial accident exceeds the threshold values specified in the regulation.
- Even if the quantities of hazardous substances do not exceed the threshold values, the summation of the quantities of all hazardous substances present at the establishment may cause the establishment to be categorized as an establishment of UTE or LTE. The summation of hazardous substances is then based on the following formulas:

a) the establish is UTE if the sum of:

$$q_1/Q_{U1}+q_2/Q_{U2}+q_3/Q_{U3}+q_4/Q_{U4}+\ldots\ldots+q_x/Q_{Ux} \quad (1)$$

is greater than or equal to 1,

where the individual symbols mean:

- q_x- the quantity of dangerous substance x (or category of dangerous substance) belonging to the substances included in the scope of the regulation,
- Q_{Ux} - the relevant qualifying quantity for dangerous substance defined for an upper-tier establishment of a major accident.

b) the establish is LTE if the sum of:

$$q_1/Q_{L1}+q_2/Q_{L2}+q_3/Q_{L3}+q_4/Q_{L4}+\ldots\ldots+q_x/Q_{Lx} \quad (2)$$

is greater than or equal to 1,

where the individual symbols mean:

- q_x - the quantity of dangerous substance x (or category of dangerous substance) belonging to the substances included in the scope of the regulation,
- Q_{Ux} - the relevant qualifying quantity for dangerous substance defined for an upper-tier establishment of a major accident.

The above summation should be carried out threefold time, separately for the assessment of health hazards, the assessment of physical hazards and the assessment of environmental hazards. The occurrence of a sum equal to or greater

than 1, in any category, causes the establishment should be classified as an upper-tier establishment or lower-tier establishment of a major accident.
If an establishment is categorized as one of these two categories of establishments, its operator is obliged to notify the plant to the competent authority of the State Fire Service and to notify the Voivodship Inspector of Environmental Protection. These plants are referred to as „Seveso establishments" (Michalik and Gajek, 2008), as they are subject to the Seveso III Directive.

3. OBLIGATIONS

The idea of harmonizing regulations for the Seveso establishments was to create transparent rules and procedures for the operation of these establishments, as well as rules for their control. Obligations related to the operation of such establishments are intended to affect safety both in the establishments themselves and the safety of the establishment's surroundings. As studies have shown, the existence of the required safety systems in upper-tier or lower-tier establishments affects the ability to react quickly, which is an extremely important issue in the event of a major industrial accident (Pęciłło, 2020).
Depending on whether one is dealing with an upper-tier establishment or a lower-tier establishment of a major accident, the operator of the establishment has other obligations.
In the case of a lower-tier establishment, according to Article 251 of the Environmental Protection Law, the establishment operator is obliged:

- to prepare a major accident prevention program and
- develop and implement a safety management system as a tool for implementing the program.

In an upper-tier establishment, in addition to the above elements, it is mandatory:

- to draw up a safety report,
- to draw up an internal emergency plan,
- submission of relevant documents and information to the provincial commander of the State Fire Service to prepare an external emergency plan.

In addition, the operator of the establishment has obligations to provide relevant information to the public. This information should be on the establishment's website and should be provided in a form that the average citizen can understand. The scope of this information includes:

- Information common to upper-tier and lower-tier establishments:
  - identification of the establishment operator and a description of the plant's activities;
  - confirmation that the plant is subject to the provisions of the Seveso III Directive and that this has been reported to the relevant state authorities;
  - characteristics of dangerous substances stored in the area of the establishment;
  - and the means of warning the public and the rules of conduct in the event of an industrial accident, which have been agreed upon with the relevant authorities of the State Fire Service.
- Additionally, the upper-tier establishment shall provide information on:

- safety reports prepared and submitted to the relevant services;
- scenarios of possible major-accident scenarios, together with safety measures that can be used during a major accident

Expanded information obligations were added in the Seveso III Directive, their detailing is the result of a change in the European Union's approach in issue of making citizens aware of their safety. Such information is particularly important for the operation of old Seveso establishments, as they can be dangerously close to residential development (Stefanescu, 2018). New plants are already subject to strict rules for their location.

4. DATA ANALYSIS

4.1. Seveso establishments in EU

The European Commission's report published 2021 on the implementation and efficient functioning of Directive 2012/18/eu on the control of major-accident hazards involving dangerous substances for the period 2015-2018 (Seveso III Directive) (European Commission, 2021) positively assessed the process of implementing the directive with a direct impact on the safety of citizens. An improvement in the application of the directive's provisions compared to data from previous years was also noted.

According to the data contained in the report, we can conclude that in the European Union almost 12,000 upper-tier and lower-tier establishments of a major industrial accident were noticed in 2018 (Fig.1).

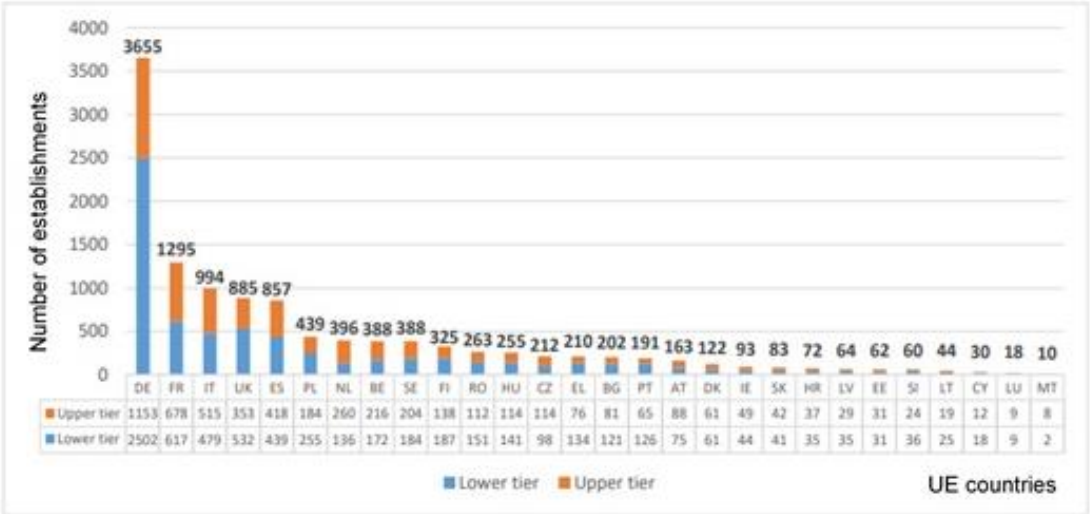


Fig.1 Number of upper-tier and lower-tier establishments of a major accident in European Union countries in 2018. Source: (European Commission, 2021)

The dominant position in this list is occupied by Germany, in 2018 there were registered 3655 Seveso establishments, of which there were 1153 upper-tier establishments and 2502 lower-tier establishments. For comparison, in Poland in 2018 there were 439 establishments: including 184 upper-tier establishments and 255 lower-tier establishments, which gave us the 6th position in terms of the number of Seveso establishments. Only France, Italy, the United Kingdom and Spain have more establishments than Poland.

Analysing activities of upper-tier and lower-tier establishments we can observe that the most common industries are: general chemicals production and distribution (15.1%), power generation, supply and distribution (13.2%), fuel storage (9.8%) and wholesale and retail (7.6%). These four activities state 45% of all (European Commission,2022).

One of the criteria adopted to assess the proper implementation of the Seveso III directive in the report was that an upper-tier establishment a major accident should have an external emergency plan. These plans ensure proper preparation and the most effective implementation of measures necessary to protect the environment and the population in the event of a major industrial accident. In Fig.2 data from EU countries on the percentage of establishments with external emergency plans was shown.

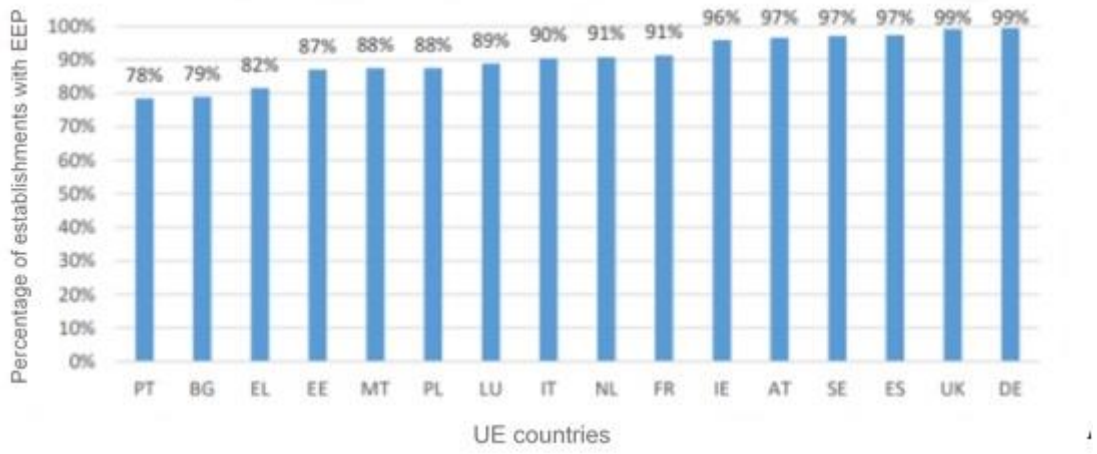


Fig. 2. The percentage of establishments with external emergency plans (EEP) in EU countries during 2015-2018. Source: (European Commission, 2021)

The highest percentage of upper-tier establishments with external emergency plans is in Germany and the UK (99% each), as well as Estonia (97%), Sweden (97%) and Austria (96%). In Poland, 161 out of 184 establishments had external plans, which is 88% (Directorate-General for Environment EC, 2022).

The aim of the Seveso Directive was to introduce measures to reduce the occurrence and, if a major industrial accident had already occurred, to reduce its negative effects. Therefore, one of the most important indicators describing the effectiveness of the directive's provisions is the real number of major accidents occurring in Seveso establishments.

As defined by Article 3, paragraph 13 of the Seveso III Directive: „major accident means an occurrence such as a major emission, fire, or explosion resulting from uncontrolled developments in the course of the operation of any establishment covered by this Directive, and leading to serious danger to human health or the environment, immediate or delayed, inside or outside the establishment, and involving one or more dangerous substances". A similar definition can be found in Article 3, paragraphs 23 and 24 of the Environmental Law. In Fig. 3 a summary of major accidents occurring in 2000-2018 in the EU was presented.

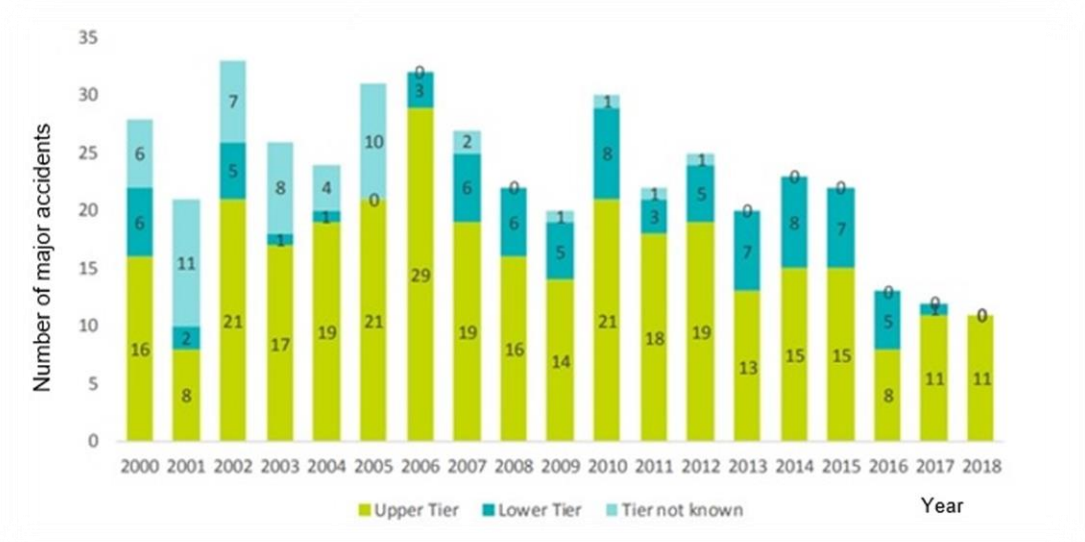


Fig. 3. Number of major accidents occurring in 2000-2018 in the EU in upper-tier, lower-tier and other establishments. Source: (European Commission, 2022)

As it can be seen, a significant decrease in the number of major accidents over almost two decades, which shows that the introduction of stringent safety procedures (Krzysiak at al., 2021) and all measures related to the operation of the Seveso directives have had the intended effect.

4.2. Seveso establishments in Poland

The number of Seveso establishments in the European Union is steadily increasing, a trend also noticeable in Poland. Their number has significantly increased from 360 in 2011 to 477 in 2021 (Fig. 4).

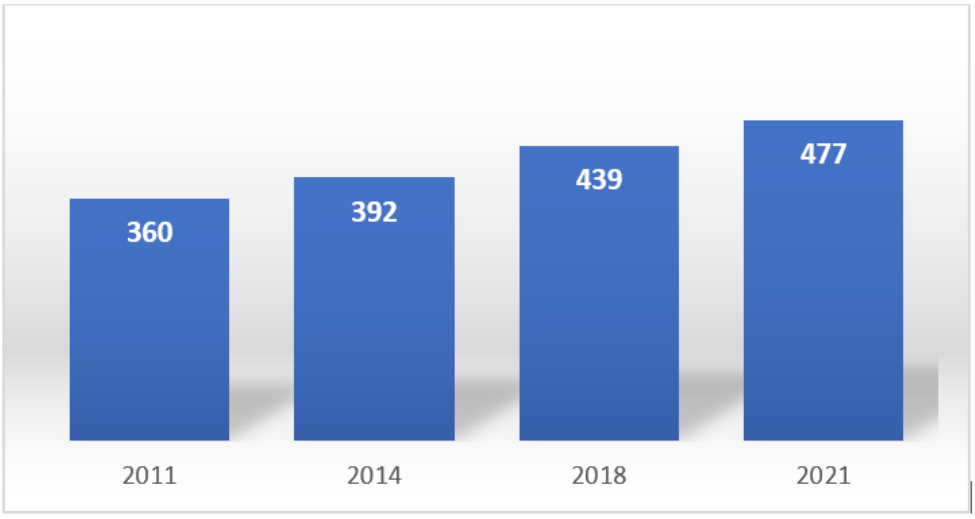


Fig. 4. Total number of upper-tier and lower-tier establishments of a major accident in Poland in the period 2011-2021. Source: own study basis on (Directorate-General for Environment EC, 2022; GIOS, 2017-2021)

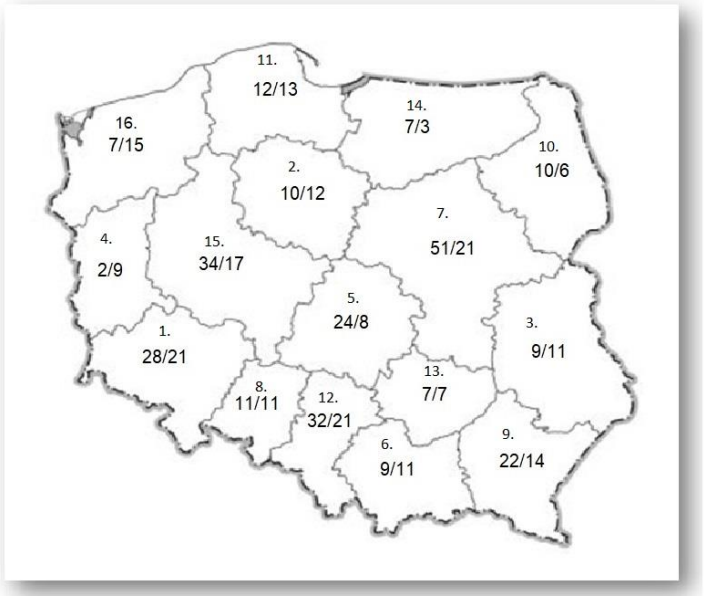
In Table 1 it was shown how the number of establishments regulated by the Seveso III Directive in Poland over the past five years has evolved.

Table 1
Number of upper-tier and lower-tier establishments of a major accident in Poland in 2017-2021

Year	Lower-tier establishments	Upper-tier establishments
2021	277	200
2020	273	195
2019	259	191
2018	255	184
2017	244	186

Source: own study basis on (GIOS, 2017-2021)

As it can be seen, the number of both categories of establishments is increasing, with the small exception of 2018, when there was a decrease in the number of upper-tier establishments from 186 to 184. The increasing number of establishments is explained by the fact of the constantly developing economy and the effectiveness of the Seveso III Directive in the area of categorizing establishments with dangerous substances as Seveso establishments.
In Figure 5 it was shown how to look at the distribution of Seveso establishments in voivodeships in Poland. By far the largest number of establishments of both categories is in the Mazowieckie Voivodeship, with as many as 72 establishments, which accounts for 15% of all establishments in Poland. This is followed by the voivodeships of Śląskie (53 plants), Wielkopolskie (51 plants), and Dolnośląskie (49 plants). On the other hand, the smallest number of plants is located in the voivodeships of Świętokrzyskie (14 plants), Lubuskie (11plants) and Warmińsko-Mazurskie (10 plants).



1.	Dolnośląskie Voivodeship
2.	Kujawsko-pomorskie Voivodeship
3.	Lubelskie Voivodeship
4.	Lubuskie Voivodeship
5.	Łódzkie Voivodeship
6.	Małopolskie Voivodeship
7.	Mazowieckie Voivodeship
8.	Opolskie Voivodeship
9.	Podkarpackie Voivodeship
10.	Podlaskie Voivodeship
11.	Pomorskie Voivodeship
12.	Śląskie Voivodeship
13.	Świętokrzyskie Voivodeship
14.	Warmińsko-mazurskie Voivodeship
15.	Wielkopolskie Voivodeship
16.	Zachodniopomorskie Voivodeship

Fig. 5. Number of lower-tier establishments/number of upper-tier establishments of a major industrial accident on the territory of voivodeships in Poland in 2021. Source: own study basis on (GIOS, 2017-2021)

All Seveso establishments on the territory of Poland are subject to constant inspections. According to national regulations, upper-tier establishments are subject to annual inspections and lower-tier establishments once every 3 years. These inspections can be carried out both by the competent authority of the State Fire Service and by Provincial Environmental Protection Inspectorates. There may also be joint inspections. These inspections are aimed at checking the compliance of the operation of upper-tier and lower-tier establishments with major accident prevention regulations. Field inspections include checks of the measures and systems used at the plant and the possession of appropriate and mandatory documentation. According to data presented by representatives of Poland in the Final Report of the "Assessment and summary of Member States' implementation reports for Implementing Decision 2014/896/EU (implementing Directive 2012/18/EU on the control of major accident hazards involving dangerous substances) inspections were carried out as planned, in the number given in Table 2.

Table 2
Number of inspections carried out by the authorities of the State Fire Service, the Provincial Inspector of Environmental Protection and joint inspections in upper-tier and lower-tier establishments in 2015-2018 in Poland

Year	Upper-tier establishments			Lower-tier establishments		
	Environ-mental Protection Inspector-ate	State Fire Service Units	Joint inspect-ions	Environ-mental Protection Inspector-ate	State Fire Service Units	Joint inspect-ions
2018	144	166	35	96	185	17
2017	158	197	35	95	178	3
2016	160	171	11	94	156	8
2015	156	116	4	74	144	2

Source: own study basis on (European Commission, 2022)

According to the data presented in Table 2, all upper-tier and lower-tier establishments have been inspected by the relevant authorities within the relevant time period. It is encouraging to see the increasing number of joint inspections, which may indicate the increasing integration of inspection services.

5. CONCLUSIONS

Analysing the data on the number of upper-tier and lower-tier establishments of a major accident, we can see that this number is steadily increasing both in Poland and on the territory of the European Union. On the one hand, this information may cause concern, since the occurrence of an industrial accident can always have disastrous consequences for both the population and the environment, on the other hand, the constant control over the operation of these establishments means that we have

knowledge of the dangerous substances accumulated there and awareness that these establishments take the subject of safety seriously, meeting all the obligations incumbent on them. In turn, the decreasing number of serious accidents allows us to conclude that the functioning of the Seveso III Directive in the European Union countries is correct, as it was confirmed in the European Commission's 2021 report. However, it should be borne in mind that operators of Seveso establishments should constantly strive to improve their safety systems and constantly exercise control over the proper functioning of all necessary safeguards in this area.

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