Current trends in the authorization of personnel for activities related to explosive atmospheres

Adriana Andris[1*], *Marius* Darie[1], *Gabriela* Pupazan[1], and *Alexandru Marian* Beldiman[1]

[1] National Institute for Research and Development in Mine Safety and Protection to Explosion - INSEMEX, 32-34 G-ral Vasile Milea Street, Petrosani, Romania

Abstract. Technological installations used for the processing, handling, or storage of flammable substances, such as flammable gases and vapours, or combustible dusts, may generate explosive atmospheres in their vicinity. Depending on their probability of occurrence and persistence, these explosive atmospheres are split into zones according to specific standards. To ensure an adequate level of operational safety, such installations must be designed, installed, operated, maintained, and repaired by personnel who are qualified and authorized for related activities. At the beginning of the paper is presented the explosion-related risk associated with the activities carried out by the personnel involved is presented, as well as the importance of professional authorization for the domain of risk of explosion locations. The second part highlights the legislative framework and authorization procedures relevant for the Romanian context. The paper ends with the results and discussions from data analysis available from the authorization process in Romania, together with the current trends identified in this field.

1 Introduction

Technological installations used for the processing, handling, or storage of dangerous substances in the form of gases or vapours or mists, even combustible dusts, may generate explosive atmospheres in their vicinity. Depending on their frequency of occurrence and duration, these explosive atmospheres are classified into zones by the relevant specific standards. To ensure an adequate level of operational safety, such installations shall be operated, maintained, and repaired, but also designed and erected by personnel who are qualified and authorized for these activities.

Economic operators operating plant in potentially explosive atmospheres have the responsibility to ensure compliant equipment with the specific requirements for explosive atmospheres, as well as the competent personnel for activities of design, erection, operation, inspection, maintenance and repair for such equipment. The compliance of the equipment is done according to the ATEX Directive for equipment and manufacturer [1], transposed into

* Corresponding author: adriana.andris@insemex.ro

national law, and the requirements for competence of personnel are established by another ATEX Directive [2], which is also transposed into national law.

2 The importance of personnel competence in explosion risk mitigation

The process of explosion-related risk assessment, as mentioned in [3], for a plant handling or processing flammable or combustible materials is stated as being the responsibility of the owner or operator of the plant. Also, the main objective is to identify the risks and potential sources of ignition. The electrical and non-electrical equipment in the installation may become such ignition sources if they are operated in a potentially explosive atmosphere.

Even if such equipment is designed and certified according to ATEX requirements to operate in such atmospheres, the effectiveness of explosion protection measures may be compromised by inadequate installation design, incorrect installation, incorrect commissioning, or use, maintenance and repair by untrained or unauthorized personnel. Taking this reality into account, the level of competence of personnel carrying out activities at all stages of the lifecycle of the installation becomes a critical factor in the prevention of explosion risks.

The activity of designing the technological plant does not directly generate an explosion risk, as it does not involve the operation of equipment or the physical presence of flammable substances. There is, however, an indirect or potentially major risk associated with this stage, since poor design may subsequently lead to conditions conducive to an explosion during the operational phase. Design errors that may indirectly lead to associated explosion risks include: inappropriate choice of equipment according to the potentially explosive areas in which it will operate, incorrect configuration of the ventilation system for dilution of the explosive atmosphere, gas or leak detection and signaling systems, earthing and protective equipotential bonding system, and errors in risk analysis.

The activity of mounting/installing equipment in areas with potentially explosive atmospheres poses a real risk of explosion, as it involves direct physical interaction with the equipment, the working environment and potential ignition sources, even if the installation is not yet in normal operating regime. Explosion risks associated with the assembly/installation activity could result from the use of electrical or mechanical equipment/apparatus that is not ATEX certified, mechanical sparking (by impact or cutting/grinding) or hot surfaces (by welding, soldering, thermal cutting), electrostatic discharges generated by proper earthing of elements, improper electrical connections, lack of monitoring of flammable gas concentrations in the working atmosphere.

The commissioning of a technological installation in a potentially explosive environment is associated with a high level of risk, as it involves the activation of potential ignition sources. The risk is amplified by possible installation errors, incomplete testing, hidden faults, or a lack of adequate monitoring.

The activity of using/operating a technological installation in a potentially explosive atmosphere supposes a permanent and real risk of explosion, because it involves the continuous operation of equipment in the presence of flammable or combustible substances (gases, vapours, dust). It is the operational phase that is most exposed to risk, because any deviation from the normal operating regime may simultaneously generate the formation of an explosive atmosphere and the activation of an ignition source, which may lead to the initiation of an explosion.

The activity of inspection for technological equipment and installations located in potentially explosive atmospheres is a low-risk activity, but it does involve significant risks of explosion, particularly when carried out in active environments or the vicinity of flammable substances. Although the inspection is classified as a non-invasive and non-

operational activity, it may activate ignition sources or be carried out in an explosive atmosphere, making the risk real, especially in the absence of adequate control measures.

Maintenance work (corrective or preventive) carried out in a technological installation located in a hazardous area is one of the most critical in terms of explosion risk. This activity often involves dismantling, adjusting, checking, or replacing components, which means direct interaction with equipment as well as the possible generation of ignition sources.

The activity of repairing equipment in an authorized workshop serving installations located in potentially explosive areas presents a specific risk, which differs from interventions carried out directly "in the field" (on site). However, even in the workshop, the risk of explosion is associated with the working conditions (the control of the workshop atmosphere), the degree of cleanliness of the equipment, the use of inadequate electrical or mechanical tools and the preventive measures applied.

It is therefore essential that persons involved in the design, installation, commissioning, operation, maintenance, or repair of installations and used in potentially explosive atmospheres have the necessary technical knowledge, practical skills, and experience according to the requirements of ATEX [2] and the applicable specific standards. Only in this way can it be ensured that the level of protection required by the design is maintained and the risk of explosion is reduced to an acceptable level.

The results of investigations done since then have shown that in the majority of accidents in explosive atmospheres, the human factor was the main cause. In this case, the insufficient knowledge of explosion protection, or lack of attention, or ignorance of the existing hazard. Therefore, continuous training and regular assessment of the theoretical and practical knowledge of personnel are essential to ensure competence and thus significantly reduce the risks and consequences arising from such accidents.

In compliance with the provisions of [2], the employer should provide for persons who carry out activities in connection with equipment and installations used in potentially explosive atmospheres, a safe environment for working that allows the activity to be carried out in safe conditions and adequate training on explosion-related measures.

The level of explosion protection of equipment and installations used in potentially explosive atmospheres is determined by three main categories of factors:

- commissioning, design, and installation;
- maintenance, operation and inspection;
- environmental conditions (humidity, temperature range, the presence of corrosive substances).

From these mentioned factors, the first two are significantly influenced by the competence, behavior and level of training of the personnel involved.

3 Authorization of personnel for specific activities carried out in potentially explosive areas, according to national regulations

Companies that carry out on Romanian territory activities of design, installation, maintenance and repair of installations which are operating in potentially explosive atmospheres shall have authorized personnel and have procedures/working instructions for these activities. In this field, the National Institute for Research and Development for Mining Safety and Explosive Protection to Explosion - INSEMEX Petroșani is recognized as a provider of specific training and authorization of personnel who carry out activities of design, installation, use, maintenance, and repair of equipment and installations which are operating in potentially explosive atmospheres [4].

At the same time, the need for personnel performing these activities to be trained and to periodically prove their competence is also mentioned in the specific standards for the field of equipment and installations for activities related to explosive atmospheres [5-7].

Based on the specific procedure used by INSEMEX Petroșani [8] for the authorization of personnel with activities related to the operation, maintenance, design, erection, and repair of such installations which are operating in spaces shadowed by the potentially explosive atmospheres, the authorization process consists of two stages: the training stage and the stage of evaluation of specific knowledge in the field.

Personnel requesting authorization for various activities in connection with equipment and installations intended for use in explosive atmospheres must meet the eligibility conditions, which require prior technical training and more than one year's experience in the current field. The personnel who apply for authorization for the field of design activity should have a technical university degree and experience in the field of design activity.

The training phase addresses the topics on fundamental concepts for explosion-related methods for prevention and protection to explosions; classification of explosive atmospheres due to flammable substances; safety requirements for electrical and non-electrical equipment, types of protection; personal protective equipment requirements; safety requirements for electrical installations, cables, and electrical networks; safety requirements for protective systems and systems for industrial ventilation.

This topic covers industrial areas (mining industry, wood industry, chemical and petrochemical industry, pharmaceuticals industry, food and agri-food industry, water and sewage treatment plants, energy and biogas production) involving the use, processing, storage of flammable substances or related activities such as: ecologization, pest control, insecticide treatment.

The stage of assessment of professional competence includes a written examination, an oral examination and a paper describing the practical aspects of the activities for which authorization is requested or a presentation of the project carried out (as appropriate).

4 Current trends in personnel authorization at the national level

The following presents the dynamics of the personnel authorization activity carried out within INSEMEX Petrosani.

The window of time used for analysis is from the beginning of 2022 to the first half of 2025 has been taken into consideration in which the distribution of personnel age, the dynamics of authorization requests by various activities, the distribution of personnel age by activities and the distribution of the number of authorized persons by activities highlighted by geographical regions have been analyzed.

The diagram in Figure 1 shows the density distribution of the age of authorized personnel.

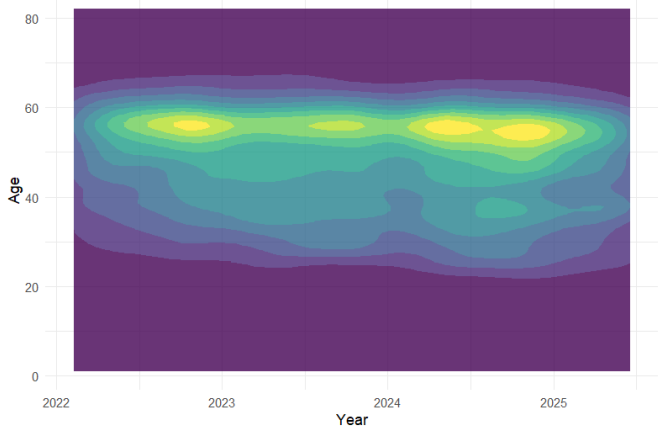


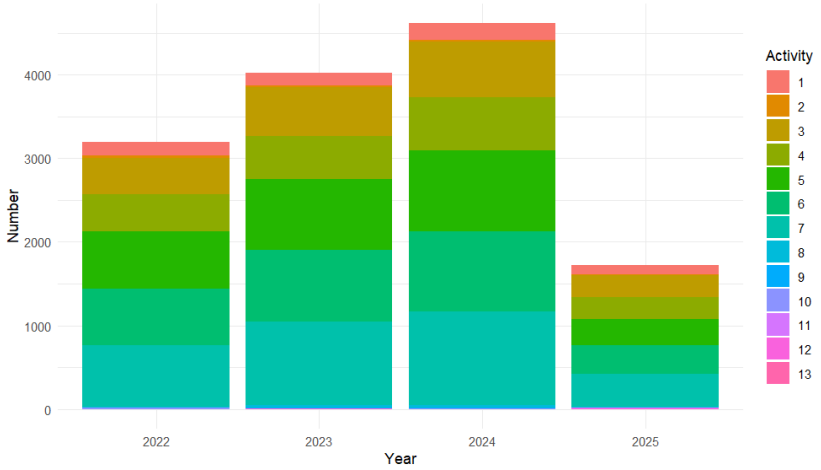
Fig. 1. Age distribution density of authorized personnel

Analysis of the age distribution of personnel involved in the authorization process reveals a gradual decline in the age of authorized persons.

This diagram highlights that the majority of persons involved in activities associated with explosion risk are around the age of 50.

However, beginning with the year 2025, a younger group of people between 30 and 40 years of age is observed.

The diagram in Figure 2 shows the dynamics of authorization requests for various activities.



Key

1	Design	8	Repair
2	Ex specification documentation design	9	Overhaul
3	Mounting	10	Production
4	Commissioning	11	Ecologization
5	Use/Operating	12	Specific tank cleaning and industrial cleaning activities
6	Inspection	13	Technical assistance during installation
7	Maintenance		

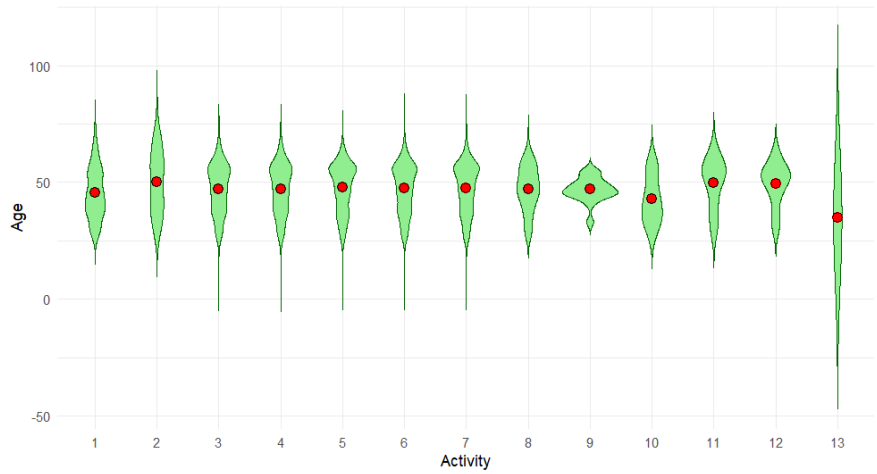
Fig. 2. Dynamics of authorization requests for various activities

From the analysis of the number of annual requests for personnel authorizations, it was found that the trend is increasing for the interval 2022-2024, and for 2025, the situation reflects the requests received until June. From one year to the next, there is an increase in the number of requests for maintenance activity, which leads to the conclusion that economic operators who operate technological installations, in the context of explosion risk, are in a process of increasing awareness of risk situations, and this leads to the need for authorization of the employees involved.

The analysis of the relative distribution of the number of requests for different activities has highlighted, in descending order, the activities of maintenance, inspection, use/operation, installation, commissioning, and design.

The visual analysis shows a preservation of the relative distribution of activities for all years.

The diagram in Figure 3 shows the age distribution of personnel by activity.



Key

1	Design	8	Repair
2	Ex specification documentation design	9	Overhaul
3	Mounting	10	Production
4	Commissioning	11	Ecologization
5	Use/Operating	12	Specific tank cleaning and industrial cleaning activities
6	Inspection	13	Technical assistance during installation
7	Maintenance		

Fig. 3. Age distribution of personnel by activity

The age distribution of the authorized personnel for the different activities, although characterized by a variety, has an average value that is kept around 50 years for almost all types of activities.

The diagram in Figure 4 shows the distribution of the number of authorized persons by activities, highlighted by geographical regions.

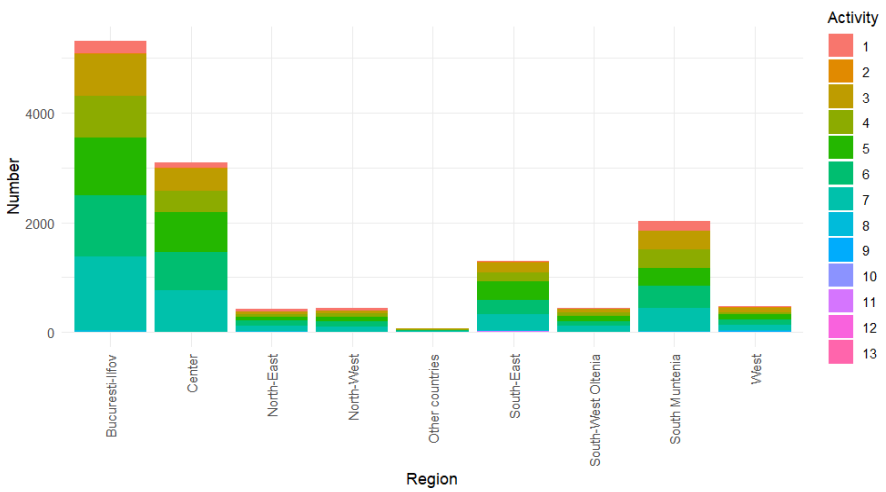


Fig. 4. Distribution of the number of authorized persons by activities, by geographical regions

From the analysis of the distribution of the number of authorized persons for different activities spread over different regions of the country, the Bucharest - Ilfov area, the central area, the southern part of the country, the southern part of Muntenia and the south-eastern part are highlighted. It should be mentioned that the Bucharest - Ilfov area, as well as the central area, includes the headquarters of several large companies that carry out activities throughout the country, such as OMV PETROM S.A., S.N.T.G.N. TRANSGAZ S.A., S.N.G.N. ROMGAZ S.A., HEIDELBERG MATERIALS ROMANIA S.A.. For the other regions of the country, the number of requests for authorization of personnel was approximately the same.

It also highlights several requests received from companies from outside Romania that needed authorized personnel in order to carry out their activities on Romanian territory.

5 Conclusions

The influence of personnel on the safety of equipment and installations in potentially explosive atmospheres is decisive, considering the fact that most of the factors contributing to maintaining explosion protection are directly conditioned by the competence, responsibility and rigor of human intervention.

An increasingly evident reality in today's workforce is the age diversity and varying skill levels of personnel involved in the operation of equipment and installations located in potentially explosive atmospheres. This heterogeneity creates challenges in both effectively passing on technical knowledge between generations and ensuring a uniform level of understanding and application of explosion protection requirements. In this context, the implementation of continuous training and regular assessment programs, adapted to the professional profile and experience of each individual, becomes essential to ensure that a high level of operational safety is maintained in explosion risk installations.

The analysis of the age distribution of authorized personnel shows a demographic profile dominated by people in their 50s, reflecting a significant accumulation of experience in the field of explosive activities. However, the trend observed from 2025 onwards, marked by the appearance of an emerging segment of younger specialists (30-40 years), suggests a possible generational renewal. This evolution may help to ensure continuity of skills, provided that effective mechanisms are put in place to transfer knowledge and strengthen expertise in explosion protection.

The upward trend in the number of applications for authorization, especially in the field of maintenance, indicates a clear trend of increasing awareness of explosion risks among economic operators. The relatively constant distribution of requests by types of activities confirms the preservation of operational priorities in the management of safety in hazardous areas.

The regional distribution of authorized persons reflects a significant concentration in areas like Bucharest-Ilfov, Centre, South Muntenia and South-East, correlated with the presence of large economic operators. For the other regions, the level of requests remains relatively constant.

This work was carried out through the NUCLEU Program EXH2 of the National Research, Development and Innovation Plan 2022-2027, supported by MCID, project no. PN23320102 and facility of National Interest Polygon for research/development and testing of explosive materials, flammable/toxic substances, anti-explosive equipment, and training of toxic/explosive environment intervention personnel, IOSIN - PCDIEx.

References

1. Directive 2014/34/EU of the European Parliament and of the Council of 26 February 2014 on the harmonisation of the laws of the Member States relating to equipment and protective systems intended for use in potentially explosive atmospheres (2014)
2. Directive 1999/92/EC of the European Parliament and of the Council of 16 December 1999 on minimum requirements for improving the safety and health protection of workers potentially at risk from explosive atmospheres (1999)
3. EN 1127-1:2019, Explosive atmospheres - Explosion prevention and protection - Part 1: Basic concepts and methodology (2019)
4. National Normative NEx 01-06, Normativ privind prevenirea exploziilor pentru proiectarea, montarea, punerea în funcţiune, utilizarea, repararea şi întreţinerea instalaţiilor tehnice care funcţionează în atmosfere potenţial explozive (2007)
5. EN IEC 60079-14:2024, Explosive atmospheres - Part 14: Electrical installation design, selection and installation of equipment, including initial inspection (2024)
6. EN IEC 60079-17:2024, Explosive atmospheres - Part 17: Electrical installations inspection and maintenance (2024)
7. EN IEC 60079-19:2019, Explosive atmospheres - Part 19: Equipment repair, overhaul and reclamation (2019)
8. https://insemex.ro/wp-content/uploads/2022/01/PSp-NEx-03.pdf, [Accessed 03.07.2025]