Statistical analysis and trends in personnel authorisation for activities related to explosive atmospheres

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Abstract. Technological installations processing flammable substances in the form of gases, vapours, mists, dusts, lint or fibres create special spaces in their vicinity called explosive atmospheres classified into zones. For these installations to operate safely, they must be designed, installed, operated, maintained and repaired by personnel qualified and authorised to carry out these activities. In the first part of the paper the risk of explosion that may occur in the performance of these activities by the personnel involved is presented. In the second part of the paper, the importance of personnel authorisation in the field of explosive atmospheres and the authorisation procedure at national level is presented. In the third part of the paper statistical analysis and trends in the authorisation process in Romania are presented.

1 Introduction

Technological installations that process, handle or store flammable substances in the form of gases, vapours, dust, lint or fibres create special spaces in their vicinity called explosive atmospheres classified into zones. For these installations to operate safely, they must be designed, installed, operated, maintained and repaired by personnel qualified and authorised to carry out these activities.

Companies owning such installations are obliged to provide both equipment suitable for use in explosive atmosphere and competent personnel to design, install, operate, inspect, maintain or repair such equipment or installations. These obligations are regulated, as regards equipment, by the ATEX Directive 2014/34/EU [1], transposed into national law by HG 245/2016, and as regards personnel, by Directive 1999/92/EC [2], transposed into national law by HG 1058/2006.

2 Explosion risk and personnel competence

The explosive atmosphere is based on the flammable substance present in the atmosphere in which the technological installation operates. Certain flammable substances may self-ignite

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in contact with oxygen in the air or may be ignited by an ignition source when they are in the optimum concentration in the mixture. Once ignition has occurred, the probability of an explosion or the risk of an explosion is very high if there is an optimum degree of dispersion of the flammable substance, if its concentration reaches a minimum value (lower flammable limit) and if the amount of flammable substance is sufficient for the ignition to spread throughout the unburned mixture [3].

According to HG 1058/2006, the employer of persons performing these activities related to equipment/facilities used in explosive atmospheres is obliged to provide them with both a safe working environment so that the work process can be carried out safely, and appropriate and sufficient training on explosion protection.

The explosion protection of equipment and installations intended for use in potentially explosive atmospheres is influenced by three factors, namely:

- design, installation and commissioning activities,
- use/operation, inspection and maintenance activities, and
- environmental factors such as humidity, temperature range, presence of corrosive substances, presence of dust.

Of these factors, the first two mentioned are strongly influenced by the personnel who carry them out. These factors are shown graphically in Figure 1.

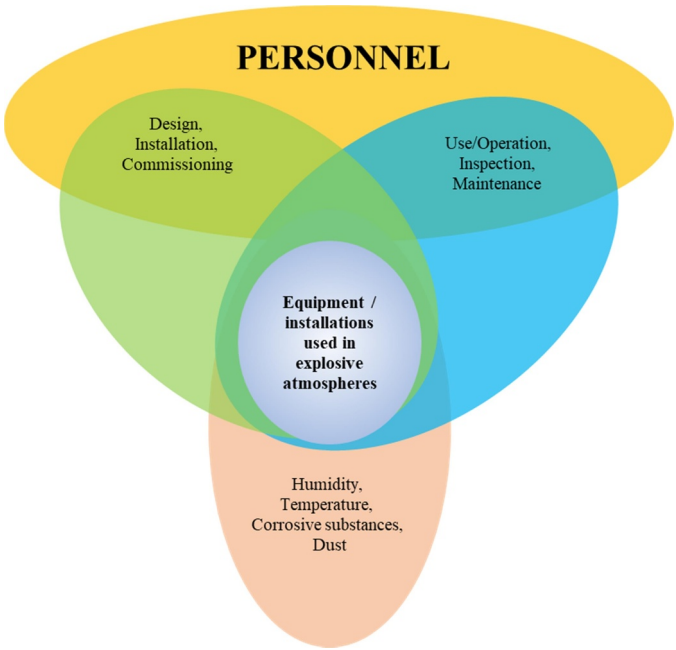

Fig. 1. Influence of personnel on the safety of equipment/installations.

In the explosion risk assessment for an installation that process flammable substances, which is the responsibility of the owner of this installation, the main objective is to identify the hazards or sources of ignition/explosion. The electrical or non-electrical equipment and components that make up the installation are one such potential ignition/explosion source [4-8].

Even if such equipment and components are certified to operate in a specific explosive atmosphere, the characteristics of the type(s) of explosion protection applied may be invalidated by improper activities of design, installation, commissioning, use or maintenance. For this reason, personnel carrying out such activities must have the necessary knowledge, skills and experience in this field.

Investigations have shown that in the majority of workplace accidents where an explosive atmosphere is present, the human was the main cause either due to poor knowledge of explosion protection or due to inattention and ignorance of the hazard. Therefore, regular training and assessment of theoretical and practical knowledge, confirming the competence of the personnel involved in these activities, also implicitly contributes to minimising the risks and consequences of accidents.

3 Authorisation of personnel for specific activities related to explosive atmospheres at national level

In Romania, companies carrying out design, installation, maintenance and/or repair of installations operating in potentially explosive atmospheres must have authorised personnel and work procedures/instructions for these activities. This requirement is stipulated in Normative NEx 01-06/2007 which recognises the competence of the National Institute for Research and Development on Mining Safety and Explosion Protection - INSEMEX as a provider of specific training and authorisation of personnel carrying out design, installation, use, maintenance and/or repair of equipment/installations operating in potentially explosive atmospheres [9].

In addition, SR EN IEC 60079-10-1, SR EN 60079-10-2, SR EN 60079-14, SR EN 60079-17 and SR EN IEC 60079-19, which mainly specify safety requirements with regard to the classification of areas within explosive atmospheres, design, inspection and repair of equipment/installations operating in explosive atmospheres, also specify the need for personnel carrying out these activities to be trained and their competence periodically confirmed [10-14].

In INSEMEX Petroșani the process of authorization of personnel carrying out activities of installation design, installation, use/operation, maintenance and/or repair of equipment/installations operating in potentially explosive atmospheres is carried out according to a specific procedure [15].

The licensing process consists of two phases: the training phase and the theoretical and practical knowledge assessment phase.

The topics covered during the training phase include the fundamental concepts of explosion prevention and explosion protection; classification of explosion hazard zones generated by combustible gases, vapours, mists and/or dusts; general and specific safety requirements for electrical and non-electrical equipment intended for use in explosive atmospheres, grouped by type of protection; safety requirements for personal protective equipment; safety requirements for electrical installations, cables and networks; safety requirements for protective systems and industrial ventilation systems.

This topic covers industrial areas involving the use, processing, storage or related activities of flammable substances such as: greening, deratization, pest control.

The conditions for the eligibility of personnel for authorisation for various activities require prior professional training in the technical field and at least one year's experience in the current field of activity. For the design activity, the person applying for authorisation must have a university degree in technical studies and experience in the design activity.

The process of confirming professional competence is based on the assessment of personnel by written examination, oral examination and the paper describing the practical

aspects of the activities for which the authorisation is requested or the presentation of the realised project (as appropriate).

4 Statistics and trends in personnel authorisation

In the following, statistical data and trends in the personnel authorization activity of INSEMEX Petroșani are presented.

The reference period between 2011 and 2021 was taken into account, for which the dynamics of applications for staff authorisation, the proportion of women in relation to the total number of applications and the age of authorised persons were analysed.

The graph in Figure 2 shows an upward trend for the annual number of personnel authorisation requests. The effect of the pandemic on this activity is also visible.

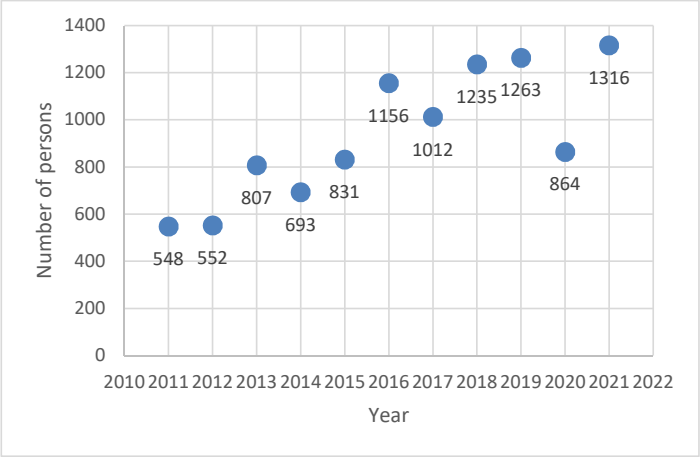

Fig. 2. Evolution of personnel authorisation requests.

The graph in Figure 3 shows a stationary proportion of women in the annual number of applications for authorisation.

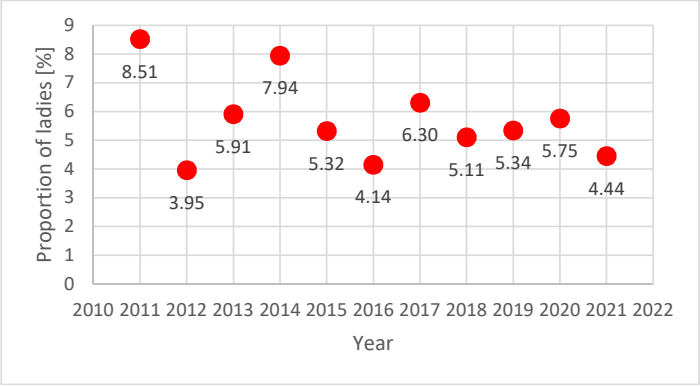

Fig. 3. Proportion of women within the authorised personnel.

The density diagram in Figure 4 shows the variation in personnel age over the reference period.

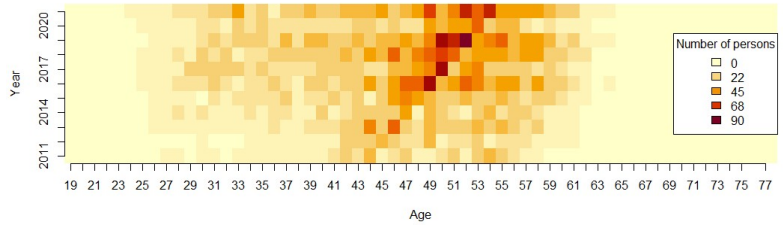

Fig. 4. Variation in the age of authorised personnel - density diagram.

It can be seen that at the beginning of the reference period, the majority of authorised personnel were around 40 years old and at the end of the reference period, the majority of authorised personnel were around 50 years old. This is largely due to the fact that these are the same personnel who have presented themselves for reauthorisation. A prediction of this situation is that the majority of currently authorised personnel will retire in 10 years and a significant gap of competent personnel will remain in the field. However, there is also a glimmer of hope in this diagram, as at the end of the reference period there is a young sample of personnel in their 30s who have presented for authorisation. Also visible at the end of the reference period is an age gap of around 20 years between generations which may be the cause of a discontinuity in the transfer of knowledge in the field of explosion risk.

Figure 5 shows the dynamics of authorisation applications distributed by various activities.

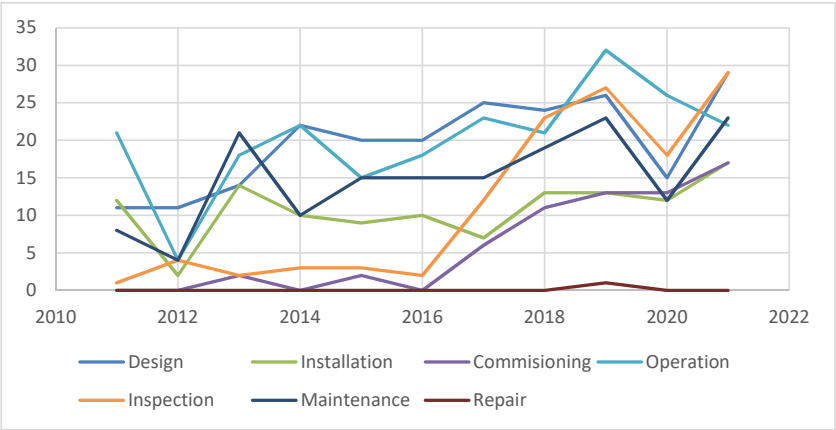

Fig. 5. Dynamics of applications for authorisation by various activities.

This diagram shows that maintenance, operation and installation activities are on an upward trend, while design and repair activities are showing moderate growth. A particularly dynamic trend is also visible for inspection and commissioning activities. Between 2016 and 2018, these developments highlight the growing concern of companies to maintain the safety regime of equipment with regard to the risk of explosion.

The diagram also shows the decline during the pandemic period and the return to previous values for personnel authorisation applications.

According to the diagram, it can be deduced that the period 2016 - 2019 was a period of investment for employers, also reflected in authorisation applications.

Table 1. Proportion of women by activity, over the period analysed.

Design	Installation	Commisioning	Operation	Inspection	Maintenance	Repair
40,56%	17,87%	1,54%	9,75%	2,61%	4,89%	0,01%

An analysis of the proportion of women in the number of authorised persons (Table 1), broken down by the activities covered by the authorisation, reveals a particular situation, namely that almost half of the authorised personnel for design activities are women, although the average percentage of women in the number of authorised personnel is around 5%.

The diagram in Figure 6 shows the evolution of the average age of authorised personnel during the reference period.

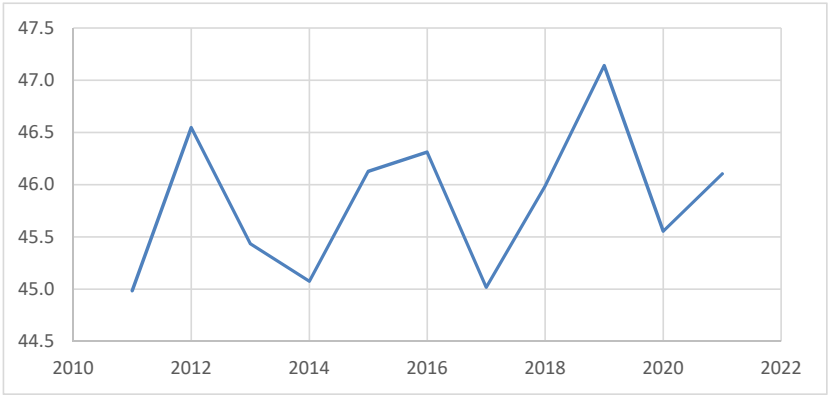

Fig. 6. Average age of authorised personnel.

Here it can be seen that the age of about 46 is slightly increasing with the passing of time. The pandemic period represented a decline of the average age, which is explained by the difficulty recorded by participants in the transition to the remote authorisation procedure implemented during the period of the pandemic.

5 Conclusions

Personnel have an overwhelming influence on the safety of equipment/installations from the point of view of explosion protection, which results from the proportion of factors influenced by them.

A situation conforming with the context of today's workforce is the variation and number of competent personnel in the use of equipment and installations in the context of explosion risk.

In 2016-2018, there was a significant increase in the level of awareness of the risk of explosion reflected by the number of applications for personnel authorization for inspection activity.

For the same period, there are also visible signs of an investment process reflected by an increased number of applications for installation activity.

The analysis carried out anticipates the appearance of a critical situation around 2030 in terms of the number of personnel with competence in the use of equipment and installations in the context of the risk of explosion.

At present, the existence of a window in the age histogram of competent personnel in the field of the operating of equipment and installations in the context of explosion risk may be an impediment to the transfer of know-how in the field.

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