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HEALTH AND SAFETY RISK ASSESSMENT AT WORKING PLACES FROM BOTORCA GAS COMPRESSION UNIT

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Purpose. to allow the safety and health level of the workers to increase in the natural gas extraction industry. **Methodology.** It was analyzed occupational risk assessment at botorca compression station. **Results.** SN GN ROMGAZ SA Medias is the most important unit in the country of extraction and storing natural gases in underground inventories and the most important work equipments within ROMGAZ SA Medias are the gases compression stations. For the most representative, Botorca Gas Compression station in the company, in the present study, the risk assessment of occupational accidents and diseases was carried out and the appropriate protection and prevention measures have been established. **Originality.** From the values analysis it appears that the global risk value for the same profession categories, regardless of workplace is the same. The electrician, motorist, lathe and welder operators profession belonging to the compressor stations poses a medium risk level and the other professions represent low-risk. **Practical value.** The obtained results will allow the safety and health level of the workers to increase in the natural gas extraction industry. References 10, tables 1, figures 4.

Key words: blasting, strength properties, massif, wells, explosive charge.

ОХОРОНА ПРАЦІ ТА ОЦІНКА РИЗИКІВ НА РОБОЧИХ МІСЦЬ ДЛЯ BOTORCA GAS COMPRESSION UNIT

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SN GN ROMGAZ SA Medias є найбільшою в країні структурою з видобутку і зберігання природних газів в підземних кадастрах, а отже – найбільш важливими об'єктами в межах цієї структури є газові компресорні станції. На основі однієї з таких станцій, а саме – Botorca Gas Compression station, проведено оцінку ризику нещасних випадків на виробництві та професійних захворювань. Було проведено відповідні попередження і були встановлені заходи захисту. Отримані результати дозволять забезпечити безпеку і здоров'я робочих. А також – попередити можливі нещасні випадки при збільшенні рівня видобутку природного газу.

Ключові слова: видобуток і зберігання природного газу, підземні запаси, оцінка ризику, газ.

RELEVANCE OF THE WORK. Improving safety and health at work in the natural gas extraction industry depends on the manner in which the European Directives provisions are acknowledged and implemented in practice or the provisions of the laws and the government decisions applicable to the natural gases extraction industry, which

specifies the minimum requirements in order to encourage improvements at the work environment and at the same time to ensure a better level of health and safety.

The National Society of Natural Gases «ROMGAZ – SA Medias» was established in June 2001 under HG nr. 525/14 by the merger of the Commercial Company Exploration and Production of Natural Gases «EXPROGAZ» SA with the National Society of Natural Gases Underground Storage «DEPOGAZ» – SA.

ROMGAZ S. A. main object of activity is the extraction and storage of natural gases. The exploitation activity of natural gases deposits under the society concession are in progress through the three branches of production: Medias, Tg. Mures and Ploiesti which together exploit the gas pools with productive wells and compression stations. The wells are bounded by incoming conduits to the group of wells and are connected to the National Gas Transmission System.

The compressor stations used in transportation on the gas mains can be of three types:

- compressor stations from the initial point of the pipeline;
- intermediate stations
- final point stations

In the intermediate stations there are used single-stage compressors and a compression ratio of 1.6 to 2. The initial stations are similar to the intermediate ones having in addition, if necessary, a drying and a gas purification station. At the initial stations, the delivery pressure is the same with the adequate pressure from the intermediate stations. Instead the input pressure is not constant, depending on the pressure in the collection pipeline of the gas field. The final station must provide a sufficient delivery pressure because once the gases reach the delivery station, it must have the necessary pressure to supply various consumers.

The Botorca Gas compression station - Sibiu County (Fig. 1) belongs to Romgaz SA Medias Branch and performs the compression process of the extracted natural gas which is transmitted at the transportation pressure in the SNGN national networks.



Figure 1 – The gas compression station

The Botorca gas compression station consists of:

- moto-compressor room;
- driving, command, signaling, measurement and lighting electrical installation;

- tap manifold, gates, pipelines, over-pressure jet valves, electrical and mechanical installation afferent to the tehnological installation, mounted outside in the open-air.

The aim of work is to allow the safety and health level of the workers to increase in the natural gas extraction industry.

MATERIAL AND RESULTS. At first we need to analyze occupational risk assessment at Botorca compression station:

1. Presentation of the occupational risk assessment method.

The proposed evaluation method aims to determine the quantitative risk level at Botorca compression station within SNGN ROMGAZ SA Medias, based on the systematic analyse and the risk assessment of occupational accidents and diseases. The essence of the method rests in identifying all risk factors from the analyzed system based on some predetermined checklists (list of risk factors) and the risk size quantification based on the combination between the severity and frequency of maximum foreseeable consequence.

Due to the accumulated and processed datas, the adopted evaluation method allows the substantiation of the technical and organizational measures, having a preventive character in order to reduce the risk of injury. The workplace is conceived as a complex system, structured from the following elements that interacts: *work equipment, work environment, work task, worker*.

The global risk level (N_r) per workplace is calculated as a weighted average of the established risk levels for the identified risk factors. In order that the obtained result to reflect the reality as much as possible. It is used as weighting factor the risk factor rate which is equal to the level of risk.

$$N_r = \frac{\sum_{i=1}^n r_i \cdot R_i}{\sum_{i=1}^n r_i}, \quad (1)$$

where: N_r = global risk level per workplace;

r_i = risk factor rate 'i';

R_i = the risk level for the risk factor 'i';

n = the number of risk factors identified at the workplace.

2. The description of the work system afferent to the Botorca gas compressor station.

Within Botorca gas compression station, the compression process of natural methane gas is carried out and it is transmitted into the afferent SNGN national networks

The work system component elements for Botorca Compression station are:

Component elements of the evaluated work system

a) Work equipment (WQ): motor-pump, command button, electrical valve, pressure switch, magneton, cooler engine, electromagnet, electrical heater, bendix, plugboard, connection box, relay box,

b) Work task (WT):

The work task for each professional category within Botorca compression station is described in the job description that were made available by the beneficiary.

c) Work environment (WE):

The workers develop their activity in the area of the compression station, the work environment is characterized by normal values of the parameters: temperature, humidity, air currents' speed and also the presence of noise and vibration nuisances.

d) The worker (W):

The main professional categories of surveillance and execution that develops its activity within the Botorca compression station are: 6 team leaders, 1 motorist, 7 compressor operators, 6 electricians, 6 mechanical locksmiths and 1 milling machine operator.

3. The professional risk assessment for the «COMPRESSOR OPERATOR» position – Botorca Gas Compression Station

The aim of the work process is to ensure the exploitation and maintenance of the gases compression facilities and equipment components in safety conditions. The evaluated component elements of the work system are integrated below

a) Capital goods

- Moto-compressor
- Turbo-compressor

b) Work task

The work tasks are those recorded in the job description

c) Executant

- Qualification: Specialized High School, vocational school - mechanic profile;
- Experience: minimum 5 years;
- Others: - dexterity and good coordination of movements;

- will perform an annual medical examination to confirm the occupied position

d) Work environment

The Work environment in which the compressor operator develops his activity, is characterized by:

- The air variable temperature - depending on the meteorological conditions
- The air currents in open air and also within the station- due to the natural draft and leakiness
- Background noise

All these aspects make the workplace assessment necessary and the quantification risk level of occupational injury and disease at the Compressor operator post.

For the «Compressor operator» position, considering the datas from the evaluation card and applying the calculation formula of the adopted method, the global risk level may be calculate:

$$N = \frac{\sum_{i=1}^{25} f_i \cdot R_i}{\sum_{i=1}^{25} f_i} = \frac{2(4 \times 4) + 14(3 \times 3) + 5(2 \times 2) + 4(1 \times 1)}{2 \times 4 + 14 \times 3 + 5 \times 2 + 4 \times 1} = 2,84, \quad (2)$$

where: N =global risk level per work;
 R_i =the risk level for each risk;
 r_i =risk factor rate.

For the «Compressor operator» position, the quantified value of the risk level of 2,84 indicates a low risk according to the classification scale of risk levels. The risk level value indicates an acceptable work situation but also in this case it is necessary to adopt technical-organizational prevention measures of occupational accidents and diseases, which have been established but are not presented in the article.

In Fig. 2 there are presented the partial risk levels depending on the risk factors for the workplace «Compressor operator» position, for which the global risk level has the value of 2,84.

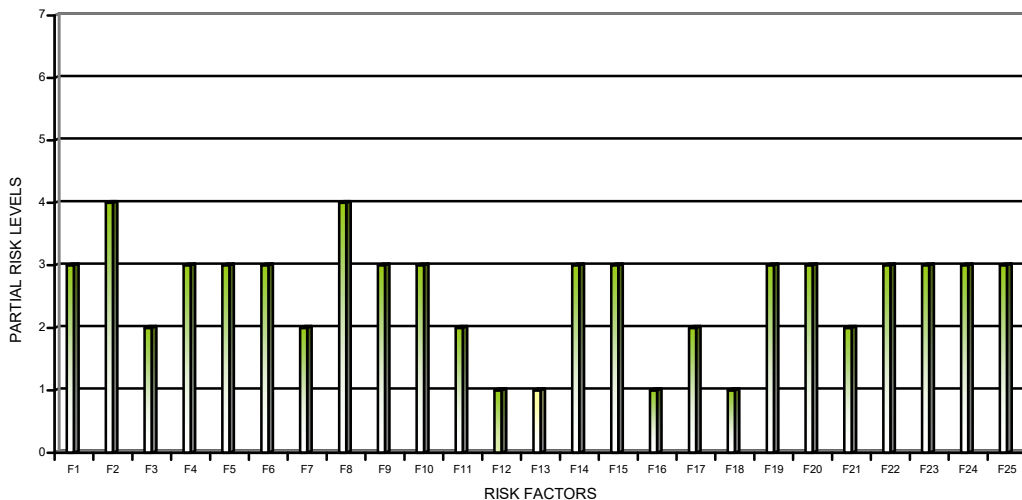


Figure 2 – The partial risk levels depending on the risk factors for «Compressor operator» position

3. The interpretation of the evaluation results at botorca compression station.

The global risk level calculated for the «COMPRESSOR OPERATOR» position is equal to 2,84, this value encloses it into the job category with unacceptable risk level.

The result is backed by the «Evaluation card of the workplace» «Compressor operator» position from which it can be observed that from the total of 25 identified risk factors, only 2 exceed as a partial risk level, value number 3 fits in the medium risk factors category.

The two risk factors which fit in the unacceptable area are:

- F2** Dangerous movements - lack of protectors in the hazardous areas – transmissions by belts, cardans,couplings - N.V.P.R. 4
- F8** Electrocution by direct touch – non-insulated cable heads, non-secured panels, improvised connections - N.V.P.R. 4

In order to diminish or eliminate the two risk factors that are situated within the unacceptable area, the generic measures listed in the proposed measures card for the workplace «Compressor operator» are necessary.

The repartition of the risk factors depending on the generating sources is the following:

- 40 %, specific factors for capital goods;
- 20 %, specific factors for work environment;
- 12 %, specific factors for work tasks ;
- 28 %, specific factors for workers

The weight risk factors identified depending on the work system elements for the «Compressor operator» position with a global risk level = 2,84 is shown in Fig. 3.

From the analysis of the workplace/ «Compressor operator» position evaluation card (sheet no. 1), it can be observed that 48 % of the identified risk factors can have irreversible consequences (DEATH) on the worker.

The weight risk factors identified depending on the maximum expected consequence for the«Compressor operator» position having a global risk of 2,84 is shown in Fig. 4 as follows:

- ITM 3-45 = 40% ; ITM 45-180 = 8 % ; INV Gr.II = 4% ; Death = 48%

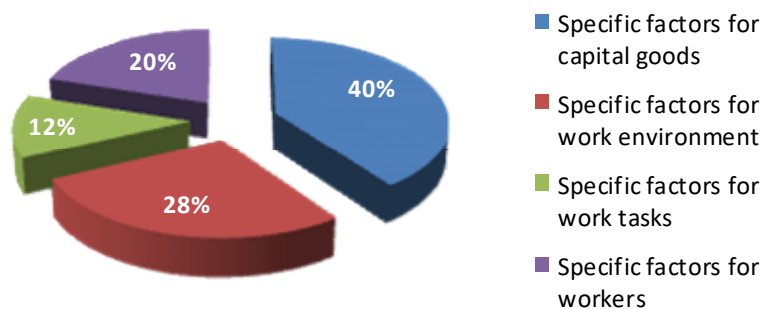


Figure 3 – The weight risk factors identified depending on the work system elements-Workplace/«Compressor operator» - global risk level: 2,84

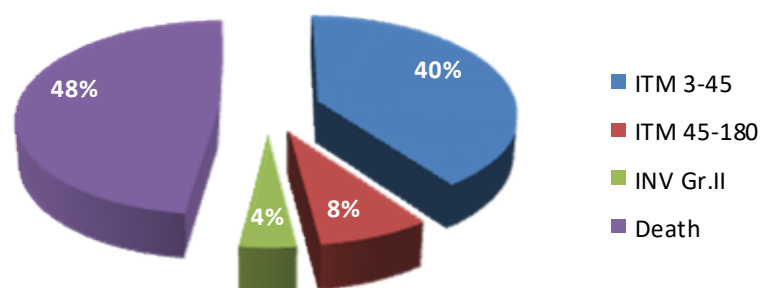


Figure 4 – The weight risk factors identified depending on the maximum expected consequence - workplace/«Compressor operator» position - global risk level: 2,84 (ITM 3-45 = 40 % ; ITM 45-180 = 8 % ; INV Gr.II = 4% ; Death = 48%)

According to the presented method we have determined the risk level for all the professions and for the other Compression stations within SNGN Romgaz Medias (table 1).

Table1 – The global risk level associated with the compression stations / profession

Branch Profession	Botorca station
Station manager	2,38
Work team leader	2,38
Electrician	3,09
Compressor operator	2,84
Mechanical locksmith	2,90
Milling machine operator	2,97
Motorist	3,44

From the values analysis it appears that the global risk value for the same profession categories, regardless of workplace is the same. The electrician, motorist, lathe and welder operators profession belonging to the compressor stations poses a medium risk level and the other professions represent low-risk.

From all of the professions that belong to SNGN ROMGAZ Mediaş compression stations, the motorist profession represents the highest risk value. The risk value level indicates an acceptable work situation, but it is necessary to adopt technical-organizational measures to prevent occupational accidents and diseases.

CONCLUSIONS. Safety and health at work forms in the present one of the most substantial and important sectors of the European Union social policy. Framework directive 89/391/EEC represents the legal applicable instrument in the whole European Union, with the purpose to introduce measures to promote the improvement of workers safety and health at the workplace. The Framework Directive underlay the elaboration and adoption up to the present of a series of legislative texts, named specific directives in areas where there are significant health and safety issues which constitute the EU legislative framework for the respective problem.

The occupational risk assessment method adopted for gas compression station complies the evaluation principles and consists in identifying all the risk factors of occupational injury and disease and risk level determination based on the combination between severity and likelihood of the maximum foreseeable consequence. The global risk level per workplace was calculated as an average weighted of risk levels established for the identified risk factors.

The global risk level for the «Compressor operator» position is 2,84, being considered a representative one within the gas compression station - meaning a low risk level. The greater number of shares for the implementation of legislative provisions on the employer's part and also being acknowledge by the employees, the greater degree of safety from the society. To increase the security degree at the surface installations used for natural gas extraction, concentrated actions are required from the employer's part by applying the legal provisions of Occupational Health and Safety as well as the employee's part by applying and implementing the actions which come to support his and the collective safety.

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ОХРАНА ТРУДА И ОЦЕНКА РИСКОВ НА РАБОЧИХ МЕСТАХ
ДЛЯ VOTORCA GAS COMPRESSION UNIT

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SN GN ROMGAZ SA Medias является крупнейшей в стране структурой по добыче и хранения природных газов в подземных кадастрах, а значит - наиболее важными объектами в пределах этой структуры являются газовые компрессорные станции. На основе одной из таких станций, а именно - Votorca Gas Compression station, проведена оценка риска несчастных случаев на производстве и профессиональных заболеваний. Были проведены соответствующие предупреждения и были установлены меры защиты. Полученные результаты позволят обеспечить безопасность и здоровье рабочих. А также - предупредить возможные несчастные случаи при увеличении уровня добычи природного газа.

Ключевые слова: добыча и хранение природного газа, подземные залежи, оценка риска, газ.

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