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Practical training of intervention and rescue personnel in toxic / explosive environments within Rompetrol Petromidia Năvodari

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Abstract. The rescuer's performance falls into the "hard work" category, in terms of the effort expended, far exceeding the average global labor consumption of the worker at the active work fronts. This character of hard work is also imprinted by the fact that the professional effort contains several static components and large-amplitude oscillations, regarding the level of maximum efforts expended. The longer their duration, the harder the work. Training is a physiological training process through which an increased efficiency is obtained in the professional activity of the rescuers. The increased efficiency is obtained by raising the functional capacity of the body to the highest level. The paper presents the evolution of labor consumption, physiological parameters, as well as the structuring of the physical effort of the intervention and rescue personnel within the process of their practical training in Rompetrol Petromidia, with the aim of preparing the intervention and rescue formations for situations close to real ones. The activity within Rompetrol Petromidia is carried out under special conditions, created as a result of possible breakdowns that may lead to exceeding the concentrations of toxic or asphyxiating gases established by legislation, which endanger the personnel or material assets existing within the organization.

Introduction

Human security in the work process aims to eliminate and / or reduce potential causes of occupational accidents and illnesses, this can be achieved by eliminating and / or reducing risks.

The need to identify and assess occupational risks, the selection, implementation and monitoring of preventive actions represent the essential foundation of occupational health and safety.

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To this end, creating a safe and healthy working environment for carrying out normal activity in a hazardous environment, implies that industry personnel know the rules and work procedures so that:

• to identify hazards and appreciate the priority and importance of occupational risk assessment;

• to possess the necessary knowledge to eliminate, reduce or avoid risk;

• to intervene in the causal process of dangerous incidents, work accidents and occupational diseases in order to interrupt the chain of development of these categories of risks.

Despite all the technical and technological advances, in most industrial branches there are dangerous incidents resulting in human casualties and material damage. For this reason, the presence of special intervention and rescue teams at the units is indispensable, in order to limit / eliminate dangerous incidents that generate toxic environments and rescue personnel caught in such events.

In the 1970s, the land on which Petromidia now stands was mostly a swamp, but the ambition and work of thousands of people transformed it into one of the most modern refineries in southeastern Europe.

At first just a small settlement, mainly made up of fishermen, Năvodari has had a significant development over time. From 500 inhabitants, the demographic growth took place in the 1980s, when 26,000 people already lived in Năvodari, and currently, we are talking about one of the most important cities in Dobrogea, with 40,000 inhabitants.

Of the total area of 480 hectares that Petromidia occupies, 37 hectares were reclaimed from the sea. The first pile was driven on July 9, 1976. A lot of work was done to ensure the stability of the ground under Petromidia, so that the entire construction can withstand an earthquake of nine degrees on the Richter scale. The works at the plant lasted 13 years and about 5,000 people worked to build this refinery.

The first facility, Atmospheric Distillation, was put into operation in 1979, and since then, Rompetrol – Petromidia Refinery has expanded to 19 main facilities, becoming the largest refinery in Romania, with a significant impact in the Dobrogea area and nationally.

Rompetrol – Petromidia Refinery contributes significantly to the development of Rompetrol's activities in Romania and the Black Sea region. It connects trading and supply activities with fuel distribution through Rompetrol stations in Romania, Moldova, Bulgaria and Georgia.

The activity within Rompetrol - Petromidia Refinery is carried out under special conditions, created as a result of possible dangerous incidents that may lead to exceeding the concentrations of toxic or asphyxiating gases, vapors and/or dusts established by legislation, which endanger the personnel or material assets existing within the organization.

The object of activity of Rompetrol – Petromidia Refinery is the processing and higher valorization of crude oil and other petroleum products resulting from the primary processing and treatment of petroleum. The following categories of substances are obtained as finished products:

• fuels (gasoline and diesel) and oils;

• fuels (fuel oil and CLU);

• LPG (propane, butane, etc.);

• aromatic products (benzene, xylene, toluene);

• solvents.

The three production units of Rompetrol – Petromidia Refinery operate in an integrated system, in full synergy, offering a wide range of products. Thus, the Petromidia refinery is one of the most complex refineries, reaching the highest white product yield in the region, 85.55%wt.

Rompetrol – Petromidia Refinery (fig. 1) provides the entire stock of raw materials for the polypropylene unit within the Petrochemical Division, the company's product portfolio includes types of polypropylene (PP), high-density polyethylene (HDPE) and low-density polyethylene (LDPE).

Fig. 1. Rompetrol – Petromidia Refinery

Location of the intervention and rescue station

The rescue station is located within the Rompetrol – Petromidia Refinery perimeter in the former engineering office of the Aromatics section, next to the R.Q.C. Laboratory. Refinery.

The space allocated to the intervention and rescue station is located at ground level, in an area easily accessible for both rescuers and vehicles and has a telephone connection with the economic operator. The space allocated to this location is arranged in accordance with the requirements of Order 391 - 1637 / 2007, which regulates this activity [1].

The intervention and rescue station premises (fig. 2) ensure adequate conditions both for the theoretical training of the rescue station personnel, and for the storage and preservation of the rescue station archive, breathing apparatus, resuscitation equipment, cylinder containers and rescue materials.

Fig. 2. The intervention and rescue station – exterior view

At the location of the Rompetrol – Petromidia Refinery intervention and rescue station (fig. 3) the following are displayed in a visible place: the monthly training program, instructions regarding the handling of devices, installations and all equipment and materials necessary for providing first aid, a table with the names of the people who make up the rescue teams, indicating their workplaces, shifts, addresses and telephone numbers [2].

The personnel working within the Rompetrol – Petromidia Refinery rescue station meet, cumulatively, the following conditions: they are trained and authorized by the Rescue Authorization Group within INCD INSEMEX Petroşani and are declared medically and psychologically fit to perform intervention and rescue activities in toxic / explosive / flammable environments [3].

Fig. 3. Stația de intevenție și salvare – interior view

Within the Rompetrol intervention and rescue station - Petromidia Refinery, the following documents are kept up to date: table with the rescue station staff, rescuer training program, table with evidence of the rescuers' periodic training, table with the verification of the insulating breathing protection devices used for action, table with the interventions performed, table with the inventory of the equipment, materials and spare parts in the rescue station's equipment, personal file of the rescuers which will include: medical and psychological certificates, rescuer authorization, commitment adhesion, for the entire rescue station staff.

Practical training of intervention and rescue personnel

The most efficient intervention in the event of an unwanted event involves, in addition to the material endowment of the rescue station, the establishment and observance of training, alarm, intervention and first aid procedures [4].

In order to maintain knowledge / skills to perform specific tasks within the intervention and rescue operations, theoretical training sessions are periodically held, as well as practical training, using respiratory protection and resuscitation equipment [5].

Both theoretical and practical training of rescuers within Rompetrol - Petromidia Refinery will be carried out under the coordination of the head of the intervention and rescue station or his deputy, according to the following schedule: at least one monthly theoretical training session, of 3 hours; at least one monthly practical training session, of 3 hours (including the preparation and checking of insulating respiratory protection devices and of the injured persons' resuscitation devices).

The personnel of the intervention and rescue station within Rompetrol – Petromidia Refinery are required to attend all periodic training sessions (theoretical and practical). The rescuer who has been absent from the periodic training sessions 3 times consecutively, motivated or unmotivated, will not be admitted to rescue interventions until he regains his theoretical, practical knowledge and physical condition, which will be recorded by the head of the rescue station in a register [6].

During the practical training sessions, specific procedures for the rescuers to enter into action, the mode of action depending on the nature of the dangerous incident, procedures to be followed by the rescue formations for the evacuation and rescue of the people involved are simulated, alternatively.

The training of the rescuers within Rompetrol – Petromidia Refinery is carried out under the protection of the insulating breathing protection devices from the intervention and rescue station. Practical training will take place monthly and will take place within the Rompetrol industrial platform - Petromidia Refinery under the leadership of the head of the intervention and rescue station or his deputy [7].

The total labor consumption (denoted by A and expressed in [kgm]), related to the various types of exercises that are suitable to be carried out using the infrastructure made available for this purpose, was calculated by summing all the specific labor consumptions.

The effort that the rescuers put in on the industrial training platform of Rompetrol – Rafinăria Petromidia, is expressed in Kgm and, depending on the installations they work on, is calculated with relationships that use numerical values (0.005, 0.25, 0.35) established experimentally based on energy consumption measurements. The formulas take into account the weight of the rescuer, the respiratory protection device and the transported materials, denoted by "P", as well as the distance traveled during the test, denoted by "S".

A training session carried out within the "Rompetrol – Petromidia Refinery training platform," will be done with the fully equipped self-contained breathing apparatus in operation for a period of 60 minutes. The amount of work performed during the training must be equivalent to 10,000 Kgm [8].

Calculation of the labor consumption of the intervention and rescue personnel:

1. During this activity, the rescuers traveled the road from the intervention and rescue station to the training area of Rompetrol – Petromidia Refinery.

The amount of work done to travel a horizontal route, starting with the rescue station and ending with the training area (fig. 4) is determined by the relationship:

$$A1 = 0{,}055 \cdot P \cdot S\ (Kgm) = 0{,}055 \cdot 100 \cdot 300 = 1.375\ Kgm \quad (1)$$

Fig. 4. Horizontal training course

2. During this activity, the rescuers climbed and descended a ladder at an angle of 90^0 in the training area of Rompetrol – Petromidia Refinery. The ladder is 15 meters long, the distance traveled is 30 meters.

The amount of work done to climb and descend the external ladder, at an angle of 90^0 (fig. 5), is determined by the relationship:

$$A2 = 0,35 \cdot P \cdot S\ (Kgm) = 0,35 \cdot 100 \cdot 30 = 1.050\ Kgm \quad (2)$$

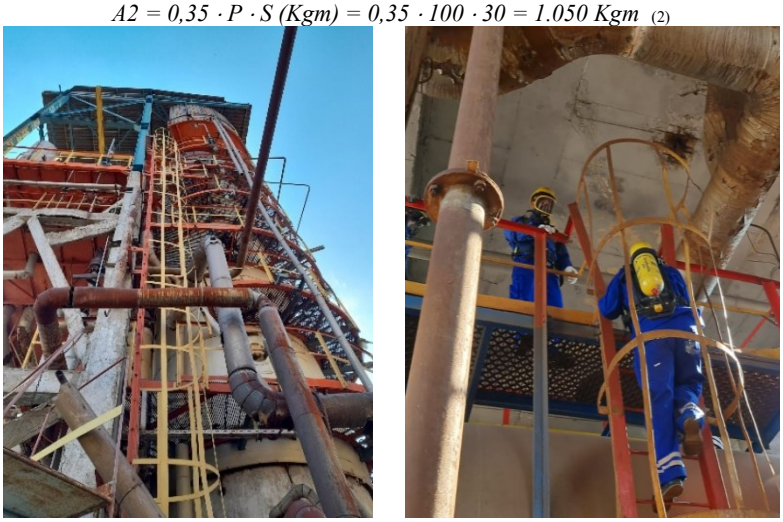

Fig. 5. Ladder at an angle of 90^0

3. During this activity, the rescuers climbed and descended a ladder at an angle of 45^0 in the training area of Rompetrol – Petromidia Refinery. The ladder is 20 meters long, the distance traveled is 40 meters.

The amount of work done to climb and descend the external ladder, at an angle of 45^0 (fig. 6), is determined by the relationship:

$$A3 = 0,25 \cdot P \cdot S\ (Kgm) = 0,25 \cdot 100 \cdot 40 = 1.000\ Kgm \quad (3)$$

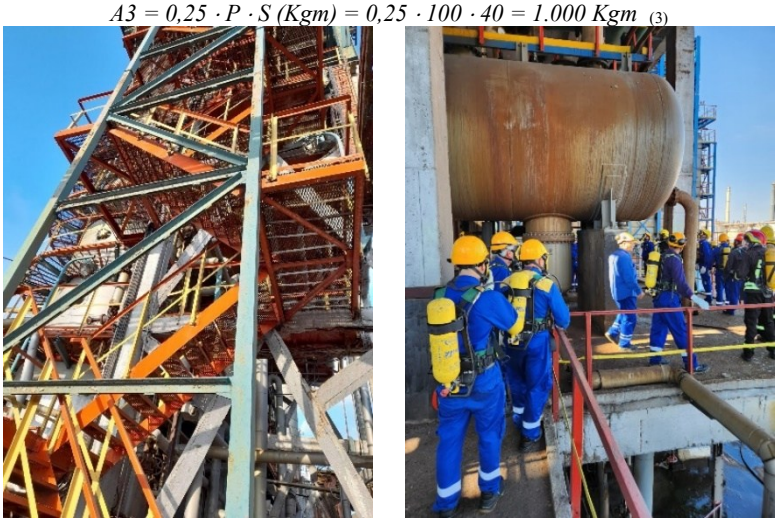

Fig. 6. Ladder at an angle of 45^0

4. During this activity, the rescuers covered the road from the Rompetrol training area – Petromidia Refinery to the intervention and rescue station, the distance covered being 250 meters.

The amount of work done to cover a horizontal route, starting from the training area and ending at the rescue station is determined by the relationship (fig. 7):

$$A4 = 0{,}055 \cdot P \cdot S\ (Kgm) = 0{,}055 \cdot 100 \cdot 250 = 1.375\ Kgm \quad (4)$$

Fig. 7. Horizontal training course

Under these conditions, the total labor consumption for the practical training carried out on the Rompetrol industrial platform - Petromidia Refinery, calculated according to the formula, will be:

$$A = A1 + A2 + A3 + A4\ (Kgm) \quad (5)$$

$$A = 1.375 + 1.050 + 1.000 + 1.375 = 4.800\ Kgm \quad (6)$$

To reach a total labor consumption of 10,000 Kgm, the rescue team, which trains on the Rompetrol - Petromidia Refinery industrial platform while wearing breathing apparatus, needs to cover the entire route twice, in 60 minutes.

Conclusions

Despite all the technical and technological advances, in most industrial branches dangerous incidents are recorded resulting in human casualties and material damage. For this reason, the presence of special intervention and rescue teams at the units is indispensable, in order to limit/eliminate dangerous incidents that generate toxic environments and rescue personnel caught in such events.

The activity within Rompetrol – Petromidia Refinery is carried out in special conditions, created as a result of possible dangerous incidents that may lead to exceeding the concentrations of toxic or asphyxiating gases, vapors and/or dusts established by legislation, which endanger personnel or material assets existing within the organization.

In order to maintain knowledge/skills to perform specific tasks within intervention and rescue operations, theoretical training sessions are periodically held, as well as practical training, with the use of respiratory protection and resuscitation equipment.

During the practical training sessions on the Rompetrol platform – Petromidia Refinery, specific procedures for rescuers to take action are simulated, alternatively, the mode of action depending on the nature of the dangerous incident, procedures to be followed by rescue teams for the evacuation and rescue of the people involved.

The effort that rescuers make on the Rompetrol – Petromidia Refinery industrial training platform is expressed in Kgm and, depending on the installations they work on, is calculated

with relationships using numerical values (0.005, 0.25, 0.35) established experimentally based on energy consumption measurements.

A training session carried out within the "training platform within Rompetrol – Petromidia Refinery," will be done with the breathing protection device, fully equipped, in operation for a period of 60 minutes. The amount of work performed during the training must be equivalent to 10,000 Kgm.

In order to safely carry out the activity of the intervention and rescue personnel in toxic / explosive / flammable environments and to make the actions taken more efficient, good physical training of the rescuers is necessary, which leads to an increase in the level of occupational safety and health, by increasing the capacity to intervene in high safety conditions, in case of dangerous incidents, accidents, disasters, etc.

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References

1. A. Gireada, G. A. Gaman, C. Ilie, D. Pupazan, C. Nicolescu, Research on changes of rescuer's energy consumption depending on their activity and type of respiratory protection equipment, 18th International Multidisciplinary Scientific GeoConference – SGEM 2018 Confernce Proceedings Vol. 18, ISSUE 1.3, ISBN 978-619-7408-37-9 ISSN 1314-2704.
2. C. Ilie, G. A. Gaman, D. Pupazan, C. Nicolescu, A. Gireada, Research on development of practical abilities of rescuers in interventions in high temperature and humidity environments, 19th International Multidisciplinary Scientific Geoconference SGEM 2019 Conference Proceedings Vol. 19 Science and Technologies in Geology, Exploration and Mining ISSUE 1.3, pag.537-544 ISBN 978-619-7408-78-2.
3. A. Gireada, D. Pupazan, C. Nicolescu, C. Ilie, A. Irimia, Optimizing the training process of intervention and rescue personnel in toxic / explosive / flammable environments, INSEMEX Publishing House, Petrosani 2019.
4. C. Ilie, G. A. Găman, D. Pupăzan, C. Nicolescu, A. Gireada, Research on development of practical abilities of rescuers in interventions in high temperature and humidity environments, 19th International Multidisciplinary Scientific Geoconference SGEM 2019 Conference Proceedings Vol. 19 Science and Technologies in Geology, Exploration and Mining ISSUE 1.3, pag.537-544 ISBN 978-619-7408-78-2.
5. I. Kovacs, C. Nicolescu, L. Toth, A. Gireada, A. Irimia, Cognitive and behavioral coping strategies used by under training rescuers, XXth International Multidisciplinary Scientific GeoConference Surveying, Geology and Mining, Ecology and Management – SGEM 2020.
6. I. Kovacs, A. Gireada, A. Irimia, L. Munteanu, Assessment of psychosocial risks associated to intervention and rescue activity in toxic / flammable / explosive environments, MATEC Web of Conferences Volume 342 (2021) 9th edition of the International Multidisciplinary Symposium "UNIVERSITARIA SIMPRO 2021": Quality and Innovation in Education, Research and Industry – the Success Triangle for

a Sustainable Economic, Social and Environmental Development" Petrosani, Romania, May 27-28, 2021 DOI: https://doi.org/10.1051/matecconf/202134201007.

7. I. Kovacs, A. Gireada, L. Toth, S. Simion, Stress and psychological resilience in intervention and rescue activities, 10th Edition of the International Symposium on Occupational Health and Safety – SESAM 2021.
8. A. Gireada, C. Ilie, A. Irimia, I. Kovacs, Research on rescuers' training process in toxic / explosive / flammable environments, 10th Edition of the International Symposium on Occupational Health and Safety – SESAM 2021.