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RISK ASSESSMENT IN THE WORKPLACE IN OIL INDUSTRY

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ABSTRACT

The risk assessment is based on the systematic recording and evaluation of all factors in the work process, the possible dangers and hazards in the workplace and in the working environment that may cause occupational injury, damage to health or illness of the employee.

Risk assessment focus is on work organization, work processes, tools, raw materials and materials used in technology and work processes, tools and equipment for personal protection at work, as well as other elements that can cause the risk of occupational injuries, damage health or illness of the employee.

The paper will give a few examples of risk assessment in the workplace in an oil refinery Brod and statistical indicators of accidents which occurred in the reporting workplace and on the intensity of repetition assess the risk of accidents and recommend measures to ensure his impairment, but also to prevent injury at work.

Key words: *risk assessments, accident, injury at work, protective measures*

INTRODUCTION

In practice there are different approaches and methodologies in risk assessment, depending on the objective and purpose of the risk assessment, as well as quantitative and qualitative indicators of the working conditions. Also, the lack of precise definition of the process, and the procedures, as well as criteria and indicators for risk assessment leads to a situation where every employer or legal entity, that performs a risk assessment, in its own way defines the procedures and evaluation criteria, which leads to lack of transparency of the results obtained, and it makes quality control assessment more difficult.

Risk assessment and measures that are determined are applied in order to eliminate the dangers and hazards in the workplace and working environment, and in order to eliminate or reduce risks, to the extent that would prevent occupational injuries, damage to health or illness of an employee, in order to improve safety and health at work. Legal basis for the assessment of risk is based on the regulations of the International Labour Organisation, the EU directives and national regulations.

Risk assessment in the workplace and measures that are determined, are provided through implementation of the Law on safety at work [1]. The process of risk assessment is regulated by the Regulations on the risk assessment in the workplace and in the working environment [2].

In order to understand the risk assessment it is necessary to define and explain terms that are commonly used and encountered while solving problems in safety and health at work. The term "accident" (eng. Accident) is defined as an unplanned event that leads to a possible injury or diseases related to work. The term "risk" (eng. Risk) can be used in different contexts, and as the subject of the work related to safety and health at work, there are many definitions of the term "risk", while one of them: "indicator which defines the degree of danger as a combination of the probability of an accident in the working environment and the severity of the consequences of accidents“.

When speaking about the concept of "risk", in fact, it is spoken about the probability (possibility) that there is a violation, and if there are any injuries which and how serious the consequences will be. It can be said that the risk function of probability of hazardous events and consequences of hazardous events (Figure 1) [3]. Risk division can be done in several ways. One of them, perhaps the most general, is that there is a risk that occurs in every workplace, and the risk that appears while doing one particular job.

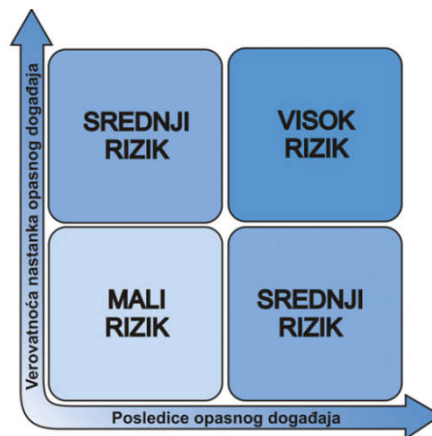


Figure 1. Risk = probability and consequences

There is another term that cannot be avoided, which is mainly used side-by-side with risk is the term "hazard" (eng. Hazard). It represents one of the basic and unavoidable concepts for the understanding of the risk management process. Also, as for the term "risk", there are several definitions of the term 'hazard' Cause that can lead to accidents in the workplace.

Although in foreign literature is nowhere mentioned any other term except the hazard (hazard), in our country the law on safety and health at work puts into use the term "harm". The main difference between hazard and harmfulness in the length of their influence. In hazard, the effect is short-lived, and at that point there is a violation. For harmfulness is a little different situation. It operates over a longer period of time, a character action ie identification. The disease is not noticed immediately but after a certain time interval depending on the type of business.

In addition to the already described concepts required for the implementation of the risk assessment process, there are still some such as "workplace", "work environment", "working tool", "preventive measures" [4]. Each of these terms has a role in the management of risk, and the risk assessment.

The aim of safety and health at work, as well as regulations governing this area, is to improve the working conditions and working environment, prevention of occupational injuries, occupational diseases and diseases related to work, protection and improvement of health of employees. In addition, it is necessary to provide a positive contribution productivity, product quality, work motivation, job satisfaction and thus, the overall quality of life of individuals and society in terms of achieving well-being at work.

In potentially explosive atmospheres there are various risks (fire risk, the risk of injury, the risk of ecological disasters, the risk of explosion, etc.). In this regard it is important to define the level and limits of risk assessment being carried out at the plant explosive atmospheres [4]. Risk assessment in

potentially explosive atmospheres must identify and analyze any danger or potential event that could result in an explosion. As an example of a risk assessment in the oil industry is taken the risk assessment in the workplace Refinery Brod. The risk assessment was done in May 2015.

DESCRIPTION OF TECHNOLOGICAL PROCESS OF OIL REFINERY BROD

The oil refinery Brod produces oil derivatives which are applied on a daily basis in the economy (industry, construction, transport, households). The oil refinery Brod is supplied with crude oil Adriatic pipeline (JANAF) which enables continuous operation. Crude oil is stored in an appropriate reservoir area in the area of the Terminal and within refineries. The total processing capacity of crude oil is 4.2 million tons per year. The oil refinery Brod now has in production capacity of the facility to 1,200,000 tons per year, a capacity of 3,000,000 tonnes per year are in preparation (removal of damage from the war, repair, modernization).

In Refinery Brod the following products stand out: Motor gasoline (BMB-95, BMB-98); Diesel fuel (Euro IV, Euro V); Bitumen (Bitumen 50/70, 70/100 Bitumen, Bitumen 160/220, Bitumen 85/40); Liquefied petroleum gas (LPG); Fuel Oil (Oil Extra, Fuel oil medium); sulfur.

The work process in the Refinery Brod is organized into 10 sections: production; Energy; maintenance; ZNR and ZOP; security; Economic and budgeted activities; Commercial and marketing activities; Legal, personnel and general affairs; Joint operations and offices of directors and Development

HAZARDS INVOLVED IN THE OIL INDUSTRY

Technological processes, as well as works with open flames near flammable liquids, gases, explosive and other substances that can cause fire must be organized in such a way that, depending on the nature and working conditions, the risk of fire is eliminated.

Analysis of explosion protection (eg. Oil platforms, oil and gas pipelines, refinery plants, etc.) Based on a systematic and comprehensive observation and analysis of processes, materials and substances and causes ignition in certain interactional relationships can lead to side effects of explosion, to that must be added and fires that may be cause and consequences of the explosion of disastrous proportions.

The complexity of new plants on one hand and failure in maintenance (or lack of maintenance) of old plants on the other hand, in conditions when the same are endangered by explosive atmospheres, makes it a serious source of hazards or technological risk [5].

Risk assessment in potentially explosive atmospheres can identify and analyze any threat or possible event that could result in an explosion.

Risk of fire and explosion in the oil refinery:

- risk of releasing - leak of the fumes of flammable liquids; - reducing the risk of pressure devices and installations which can lead to " feed " of fire and of fire and explosion;;
- hazard due to corrosion and the creation of small holes to form a possibility of entering air and the flame or the expiration flammable vapor liquids;
- damage, malfunction and unprofessional maintenance of electrical installations.

Explosive things are inherently dangerous and sensitive. Therefore, accidents occur in all areas of their life cycle. Accidents due to the appearance of a place can be divided into:

- a) accidents in the manufacture and storage of explosives
- b) accidents during transportation of explosive materials

- c) accidents in the use of explosives and
- d) accidents during testing of explosives [6].

Until the advent of explosion can occur if a potentially explosive atmosphere appears, that can be an effective cause of fire ignition. Concepts (approaches) of risk assessment (probability of occurrence and consequences) can be divided into the following three groups:

- Qualitative assessment (descriptive) at which the risk can be assessed as for example: as an acceptable, unacceptable, tolerable or small, medium, large etc.
- Quantitative assessment (numerical), which calculates the probability of unwanted events.
- A combination of the above-mentioned methods (numerical result of probability allows the classification of phenomena / undesirable events into groups (small, medium and large risks, etc.) And allows comparison of the likelihood of the occurrence of various events [4].

The basic definition of risk is that it is on a combination of probability and consequences of hazardous events [7]. Model estimates of the level of risk by Kinny method that was used for risk assessment in the workplace of Refinery Brod, starting from considerations:

- The seriousness of the consequences that an employee suffers in the occurrence of hazard and harmfulness
- The probability of occurrence of hazard and harmfulness and
- The frequency of occurrence of hazard and harmfulness.

The level of risk is defined as the product of possible damage (consequences), probability and frequency:

$$R = P \times V \times U$$

where:

R –risk level; P –consequence; V – probability; U - frequency

An analysis of jobs individually, or by checking job descriptions, employment injury, interview with managers, foremen and direct perpetrators and recording situation on the spot, it was concluded that in the analyzed sectors appear risks associated with:

- Risk of direct contact with parts of of electrical installations and equipment under voltage, the danger of indirect contact, the risk of thermal effects that develop electric equipment and installations (overheating, fire, explosion, electric shock, sparks), the risk due to lightning and atmospheric discharges, and other risks associated with power plants. It is known that the refinery produces electricity voltage of 6000 V, which is certainly one of the greatest dangers to the life and health of workers who are exposed to this voltage,
- Hazardous areas (floors and all kinds of stair surfaces with which employees come into contact, and which have sharp edges - edges, spikes, rough surface, protruding parts), which can lead to mechanical injuries (cuts, punctures and the like:)
- Work at height or depth, in terms of regulations on health and safety at work,
- Risk of slipping and stumbling when working on the drive,
- Risk of high temperatures and pressures that develop.

Of the identified hazards in the workplace and in the workplace occur:

- Chemical harmfulness, that, in some workplaces were above the allowable values,
- The vibrations that arise working turbines, engines, compressors and other equipment in the energy sector,
- Noise, which also occurs in the work of the aforementioned equipment,
- Work in the open, to which are more or less exposed all workers of energy, especially in the wastewater, given that during the summer and winter temperatures are often extremely high, or low;
- Adverse effects of the microclimate in the working premises (high or low temperature)
- Stress, which they are to a greater or lesser extent, exposed to all the workers of the refinery, each in their own field of work,
- Night work, as another adverse factor, which can lead to health damage.

The danger to be noted, and to which are exposed all workers of Oil Refinery is the risk carried by the production process and products that are created, and that is the danger of fire and explosion: The prevention of the formation of the explosion, in accordance with European Directive 1999/92 / EC (ATEX 137) is necessary and required, among other things, recognizing the dangers implemented, risk assessment, and reducing and eliminating the causes and possible consequences of risks [4,7,8].

RISK ASSESSMENT OF WORKPLACES IN OIL REFINERY BROD

The risk resulting from the aforementioned dangers and hazards in the Oil Refinery Brod, the measures taken to reduce risks, as well as the measures to be taken in order to reduce the risk, given in the tables of the risk assessment for the workplace.

Table 1. Review of occupational injuries for sector Production

Data type-sectors	2008	2009	2010
production	16	13	9

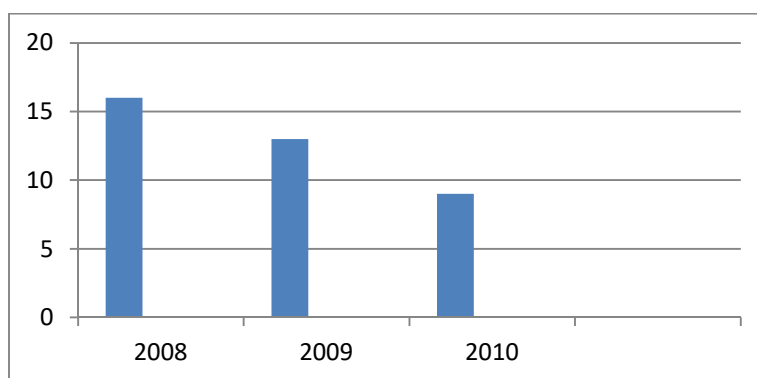


Figure 2. Injuries at work sector Production

Table 2. Review of occupational injuries for the sectors of Energy and Maintenance

Vrsta podataka-sektori	2012	2013	2014
Energetika	1	1	2
Održavanje	4	1	/

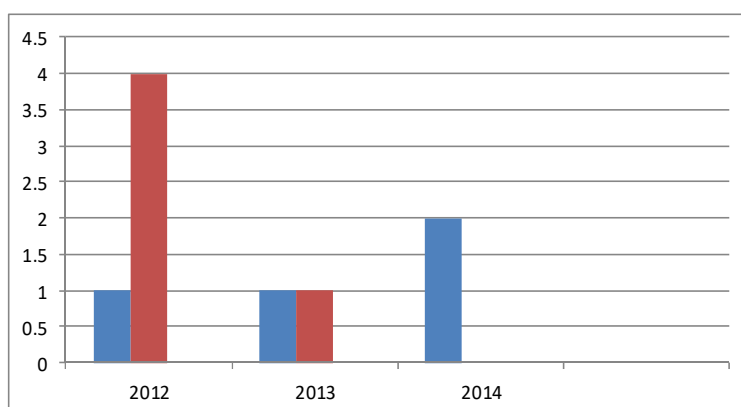


Figure 3. Injuries at work for the Energy and Maintenance

The following table provides an overview of occupational injuries for the energy sector in the last three years, on the basis of the records of occupational injuries of j.s.c. Oil Refinery, Brod.

Table 3. Review of occupational injuries for the Energy Sector

No	Date	Workplace	The work that was done at the time of accidents	source of violations	The cause of injuries	A brief description of the injuries
1	22.03. 2012.	Operator 2 demi and industrial water	Operator 2 demi and industrial water	Snake	-	When taking the valve of green areas, worker was bitten by a snake
2	05.08. 2013 .	Assistant to boiler machinist	Assistant to boiler machinist	Concrete foundation for working area access to the compressor	Lack of control over the work	During the execution of cleaning the refrigerator compressor, a worker awkwardly stepped, sprained foot and hurt himself.
3	25.02. 2014.	Assistant to operative personnel	Assistant to operative personnel	Electricity	Poor organization of work	Minutes of the Republic inspector number:24.100/173-191-19-1
4	05.03. 2014.	2 operating personnel	2 operating personnel	Tangible asset hand tools	Defects in equipment	Due to the short circuit and explosion, the pressure is dismissed worker on the tool, which caused the violation

The following table provides an overview of occupational injuries for the Maintenance Department in the past three years, on the basis of the records of occupational injuries of j.s.c. Oil Refinery, Brod.

Table 4. Review of occupational injuries in the Sector Maintenance

Date	Workplace	The work that was done at the time of accidents	source of violations	The cause of injuries	A brief description of the injuries
26.04. 2012.	Electrician Technician II	Electrician Technician II	Tangible asset - chair	Invalid object for general use - chair	Moving the unfastened seat chairs gt caused the violation of workers.
14.06. 2012.	locksmith I	locksmith I	Metal container for waste collection	Cracking of welded part hinges and door fall on the finger worker	During the refit of container worker did thinning the hinges on the rear door and hurted his finger
14.09. 2012.	locksmith II	locksmith II	Tangible asset - a hammer	Tiredness of worker due to the heavy and overtime work	When installing a screw with a hammer from hanging baskets worker is stuck to the steel cable changed direction and hurted himself:
28.10. 2012.	Technician in a shift	Technician in a shift	A chemical acidic water	Night work under reduced visibility	While edgestitching impulse lines from the column 31CO6 there was a dripping of acidic water and violation of worker
10.01. 2013.	Electrician Technician II	Electrician Technician II	A chemical sulfur hydrogen	Malfunction of the valve block for collecting gas phase for incineration	By working to dismantle the block valve on the container with a protective mask, there was a uncontrolled release of gas, which caused weakness of worker

Table 5. The results of the risk assessment by sector

SECTOR	TOTAL WORKPLACES	POSITIONS WITH INCREASED RISK
energetics	41	21
maintenance	145	88
production	166	90

For the analysis estimates are taken these 3 sectors in which employees are given the description of the tasks carried out, the equipment which is used in the work process, raw materials and materials that use, exposure to the above risks and hazards in the technological process.

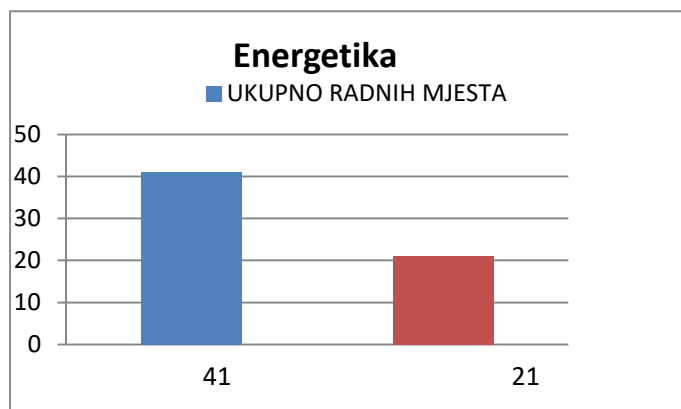


Figure 4. The number of jobs with a higher risk in relation to the total number of jobs (Energy Sector)

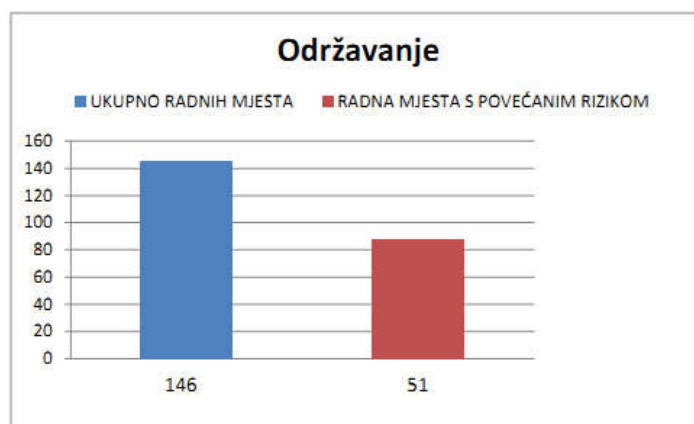


Figure 5. The number of jobs with a higher risk in relation to the total number of jobs (Maintenance sector)

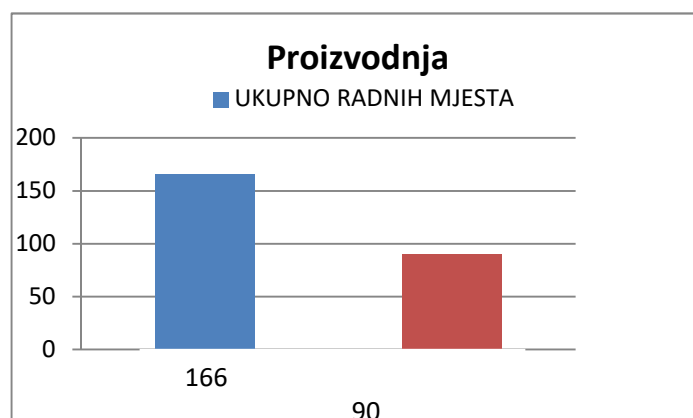


Figure 6. The number of jobs with a higher risk in relation to the total number of jobs (Manufacturing sector)

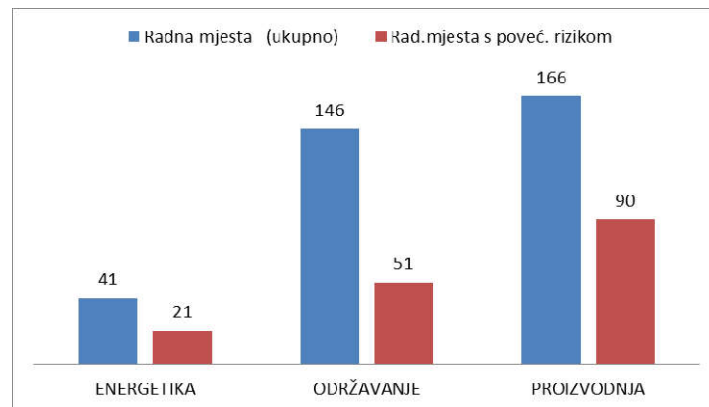


Figure 7. The total number of jobs increased risk observed in the three sectors

The total number of jobs in the sector observed is 3 353, of which 162 jobs with an increased risk: During the reporting period there were no accidents caused by explosive substances and therefore no injured or killed worker by cause of a fire or explosion.

Analysis jobs in Oil Refinery Brod, show that in this The company is a large number of jobs with potentially increased risks (energy with over 50%, maintaining over 30% and production with over 50% of the fixed place of work with an increased risk).

PROTECTIVE MEASURES ON WORKPLACES WITH INCREASED RISK

Preventive measures for fire protection in the oil industry:

- pipelines and equipment required for the transport of oil must be constructed of materials resistant to hydrocarbons and protected from corrosion with coats, or 'passive protection' and active protection - "cathodic protection";
- decanting the oil must be taken of the taking of static electricity which is produced when moving of oil through the pipeline;
- provide automatic control of pressure and temperature in the technological process and the possibility of rapid emptying of the system and taking the gaseous phase in a burning torch on the most vulnerable areas to incorporate a stable installation for the introduction of inert gases in the system;
- tanks and installations containing derivatives with low boiling points and high vapor pressure cool with water through the stable installation;
- repairs and all work with an open flame (welding, cutting and brazing) within refineries perform with the mandatory consent of the competent services of the JMC;
- in closed buildings - pump station required to predict effective natural or artificial ventilation, the walls must be a non-flammable roof of lightweight materials. In areas under threat of explosion must not sparking and must be electrically;
- electrical installations and equipment in hazardous areas must be made in explosion-proof protection.

SECURITY MEASURES AND PROTECTION AT WORK IN ENDANGERED WORKING AND TECHNOLOGICAL AREAS

1. The company is required to provide employees work, protective clothing and equipment appropriate jobs that are performed on individual workplaces: Workers are required to wear the prescribed work and protective clothing. Accountable manager shall remove from work each worker who is not wearing appropriate protective clothing and equipment or makes illegal acts that pose a threat to the working and technological unit in which it is declared as a threatened space;

2. If necessary, perform repairs on the equipment, devices and installations which are located within the danger zone before the start of the intervention, it is required to provide written permission from the appropriate service companies (determined organizational chart of operation), which will precisely define the start and end of the intervention, mode for intervention and a list of employees who will participate in the intervention and securing;
3. Issuing licenses for the repairs within the danger zone, the relevant department of the company is obliged to provide the presence of firefighters on duty and if possible the person who has professionally trained to provide first aid;
4. Intervention within the danger zone or zones of explosion can be accessed only when it is clearly established that are provided all the necessary preconditions for a safe intervention;
5. In confined spaces where there is not enough ventilation, is necessary to provide additional ventilation during the intervention;
6. During the intervention strictly prohibit any form of improvisation: If there is any dilemma which calls into question the smooth operation of the process of intervention, immediately suspend all work and consult experts.
7. The periodic tests must be carried out of the microclimate and concentration of chemical hazards in the workplace. Pay special attention to the presence of static electricity as a result of the technological processes and the introduction of charged bodies or particles..
8. The owner of ordinal and technological process is bound to the spot has BTL forms or declarations about the characteristics of all substances used in the process of the technological processes and to on-demand inspection services provided for review: This is especially true in the physical and chemical properties that are significant from the point of anti-protection.

TRAINING OF EMPLOYEES IN VULNERABLE AREAS

All staff must be trained for high-quality execution of work duties: Appropriate training is conducted in accordance with 89/391/EEC:

- Prior to the deployment of new worker into the workplace:
- In the case of switching to another position:
- In case of changes or introduction of new work / technological equipment:
- With the introduction of new technologies and technological procedures.

Inspection and maintenance of technological installations, equipment and appliances must be performed only by experienced personnel whose training included the study of different types of explosion protection and practice in the work on the installations, equipment and devices, and knowledge of the relevant rules and regulations, as well as the general principles of the classification of hazardous areas: Such personnel must at regular intervals to renew their knowledge (in accordance with: IEC 79-17 (EN 60079-17)).

In order to improve health and safety at work, and reduce the risk, the employer proposes to take the following measures:

- For jobs that are estimated as of the increased risk, periodic medical examinations perform once every 12 months, in accordance with the Regulations on preliminary and periodic medical examinations worker in the workplace of with higher risk (Official Gazette of the Republic of Srpska, No. 68/08) : General and specific part of the preliminary and periodic examinations of employees in the workplace of with increased risk, is enclosed document. For other jobs periodic inspection done once in 3 or 5 years, depending on the job (Tables Risk Assessment).
- Employees working in the workplace with increased risk of injury and damage to health have to be trained so they can help themselves if they are in danger or if they hurt or suddenly become ill.
- For first aid must be qualified technical and supervisory staff (foremen, foremen, craftsmen, managers, supervisors, etc.) And at least 2% of the total number of workers who are employed in a single work shift.

- Set guidelines for safe work on all means of production, in order to ensure the proper handling of labor and the risk of injury and damage the health of workers is minimized.
- Always use the prescribed personal and collective protective equipment:
- Take measures to reduce concentrations of benzene, acrolein, methanol and m-xylene, as it is in some places their concentration was above the permissible limit:
- Preserve in good condition and perform examinations and testing of work equipment: Timely exclusion from the use of resources and work equipment and equipment for personal protection if they pose a threat to life and health of workers.
- Follow the basic safety principles and documents for work, and make permanent control of the same.
- Floors of working premises to maintain by means which do not create a slippery surface and the dangerous for the movement of employees.
- Apply generally recognized measure of safety and health at work in introducing new technologies to the adoption of appropriate regulations.
- Analyze any resulting grave violation of the collective accident and provide mitigation measures.

CONCLUSION

Adequate analysis of criteria and indicators for risk assessment, based on standards, regulations, directives and other legislative regulations in the field of safety and health at work is one of the basic requirements to quality risk management of the working environment. Based on the above, we can see that quality risk assessment requires serious approach and risk analysis in safety, and health of workers. In this way, the risk can be significantly reduced and in most cases lead to negligible, which requires a significant investment and the risk assessment and in equipment for reducing the risk, but in this way risk for safety and health of workers is reduced to negligible.

Analysis of Risk Assessment of workplaces in the oil refinery showed a very significant share (over 50%) of workplaces with higher risk.

For all of these dangers and harmful effects, the measures are proposed for reducing the risk that would, in a longer or shorter period of time, led to the reduction of risk to the safety and health of employees in the oil industry.

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