Labor Safety in the Oil and Gas Industry

I V Iakovlev¹, A P Pesterev²

¹Master's student of the Mining Institute, North-Eastern Federal University, 50 Kulakovsky str, Yakutsk 677013, Russia.
²Associate Professor of the Mining Institute, North-Eastern Federal University, 50 Kulakovsky str, Yakutsk 677013, Russia.

E-mail: ¹kote5730@gmail.com
²Pesterev.a@mail.ru

Abstract. The management of industrial safety and occupational health associated with oil and gas production is one of the vital components of the oil and gas industry, since it is well known that most conditions of operation, processing and storage of chemicals and end products pose a serious threat to technological and environmental safety, as well as health and life of people. The main danger is posed by potential explosions and fires occurring in the places of storage and transportation of oil products, which requires constant improvement of safety methods in the industry.

1. Introduction

The oil and gas sector is potentially one of the most dangerous industries, so it must have one of the most advanced safety programs. The combination of powerful and high-tech equipment, flammable chemicals and high-pressure processes can lead to dangerous and even fatal consequences for any personnel error and equipment failure. This is why it is so important that health and safety engineers and plant managers determine recommended safety measures prior to each work shift, and also provide training on potential hazards in a specific workplace. Despite the implementation of a set of measures to ensure industrial and fire safety of tank farms, the level of protection of fire hazardous facilities is at risk. This fact indicates that the problem of fire protection of these facilities requires special attention and further improvement. The purpose of this article is to analyze the state of fire safety at the facilities for storing and transporting petroleum products using the example of the Yakutsk oil depot, identifying existing problems and finding their solutions. Based on this, the relevance of the proposed topic aimed at ensuring safety in the oil and gas industry is beyond doubt.

2. Problem statement

Activities related to the life cycle of production and maintenance of oil and gas fields, transportation and processing of products and their storage include many different types of equipment and materials [5], which are potential sources of various hazards. Recognizing and controlling threats is critical to prevent possible injury and death. There are the following risk factors that threaten the safety of workers in oil and gas complexes and service enterprises.

Road traffic accidents. Workers and equipment must be transported to and from the wells. Deposits are usually located in remote areas and require long distances to reach them. Road traffic accidents are
the main cause of death of oil production, gas production and storage workers. Approximately 4 out of every 10 workers who die in production in this industry are victims of a road traffic accident. [4]

Mechanical stress. Three out of five accidents in the oil and gas industry are the result of dangerous mechanical impact on humans. Workers can be exposed to a variety of mechanical hazards such as moving vehicles, equipment in operation, falling equipment, and high pressure accidents [7].

Falls. While working, workers may need access to platforms and equipment located high above the ground. To do this, they need fall protection and fall prevention from a tower, drilling platform, tanks and other equipment located high above the earth's surface [7].

High pressure lines and equipment. Workers can be exposed to hazards from compressed gases or high pressure pipelines. Internal line erosion can lead to leaks or line breaks, exposing workers to high pressures from compressed gases or high pressure lines. If the connections that secure the high pressure lines fail, there may be a risk of injury [6].

Electrical and other hazards associated with energy equipment. Workers can be exposed to uncontrolled electrical, mechanical, hydraulic, or other hazardous energy sources if equipment is not properly designed, installed and maintained. In addition, to ensure safe operation, it is necessary to develop and implement administrative control measures, such as procedures for checking such devices [5].

Explosions and Fires. Oil and gas workers face the risk of fire and explosion due to the ignition of flammable vapors or gases. Combustible gases such as vapors and hydrogen sulfide can be released from wells, vehicles, manufacturing equipment, or ground equipment such as tanks or shale shakers. In turn, sources of ignition can be static, electrical energy sources, open flames, lightning, cigarettes, cutting and welding tools, and hot surfaces [6].

Based on the foregoing, it can be concluded that workers in the oil and gas industry continue to be one of the groups with the highest risk of injury and death at work in comparison with all other industries.

3. Theoretical part

109 accidents were recorded at the facilities of the oil and oil and gas complexes on the territory of the Russian Federation for the period from 2015 to 2019. Below is a diagram with an approximate number of accidents for a specified period of time (Fig. 1).

![Approximate statistics of accidents at the facilities of the oil and oil and gas complex](chart.png)

**Figure 1.** Diagram of accidents in the oil and gas complex of the Russian Federation.
In the Republic of Sakha (Yakutia), the oil and gas industry is a strategic and promising sector of the economy, which provides energy supply to society and the population with hundreds of jobs. And the products of the industry provide fuel for all types of transport in the republic, which serve the vast territory of the North-East of Russia. In this infrastructure, the Yakutsk oil depot, which is the largest branch of the Sakhaneftegazsbyt open joint stock company, plays a special role in the economic and social development of the republic, supplying gasoline, kerosene and oils to all transport in Yakutsk and the republic, from cars to airplanes. In addition, it supplies oil products to boiler houses and power plants, providing heat and electricity to residential and industrial facilities in the harsh climatic conditions of the permafrost. The Yakutsk oil depot supplies more than 30% of the republic's population with oil products and is considered a critical facility. In terms of fire and explosion hazard, the facility belongs to category A (increased fire and explosion hazard) [1-3].

When analyzing reports from accident sites at gas and oil and gas facilities, we noted the following violations of technological and production requirements:

• Violation of safety requirements when carrying out gas hazardous work on pumping oil residues from the tank.
• Violation of technological discipline when carrying out the technological process in accordance with the requirements of the technological regulations for the production of products.
• Maintenance of the technological process in the absence of design and technical solutions for the safe operation of the pipeline for discharging hydrocarbon vapors from the reactor into the column in terms of equipping with a system for monitoring the parameters of steam supplied to the pipeline.

Since nuclear safety and other facilities of the oil and gas complex are hazardous production facilities, measures to prevent accidents and prevent industrial safety should be improved. As a result, the following recommendations for preventing accidents are offered:

1. Implement a system for continuous monitoring of the operating parameters of pipelines for discharging vapors from reactors into the column in terms of retrofitting with devices for measuring the temperature in the pipeline, as well as devices for monitoring the parameters of steam supplied for continuous blowdown;
2. When carrying out unscheduled work, they should be coordinated with the technical manager of the organization and ensure that these works are carried out according to the permit for high-risk work.
3. Develop and approve a list of hazardous gas works, documents (standards, instructions), clarifying and specifying the requirements for conducting gas hazardous, hot and repair work at a hazardous production facility;
4. Provide workers with explosion-proof radios, portable gas analyzers with the ability to determine oxygen and harmful substances in the air of the working area, equipment and tools that would correspond to the nature of the work performed by the workers, the operation of which is possible in the climatic conditions of the Far North.

4. Conclusions
Elimination of all violations in production and implementation of these recommendations will allow to raise the level of industrial, fire and environmental safety at oil and gas enterprises to the level of acceptability of fire risk and ensure the prevention of fires at a specific storage and transportation facility for petroleum products.

Given the hazardous nature of the oil and gas industry, the need to implement an effective health and safety management system is essential to improve health and safety performance. It is also noted that in order to prevent accidents at gas and oil fields, workers and organizations must comply with simple, but very important rules, norms and safety requirements.

5. References
[1] Federal Service for Environmental Technological and Nuclear Supervision. Supervision of oil and gas facilities. http://www.gosnadzor.ru/industrial/oil/
[2] Federal Law of December 21, 1994 No. 69-FZ "On Fire Safety"
[3] Federal Law of July 22, 2008 N 123-FZ "Technical Regulations on Fire Safety Requirements"

[4] Alistair G F, Gibb, Roger Haslam 2010 What causes accidents? Institution of Civil Engineers pp 46-50

[5] Amir Sasson and Atle Blomgren 2011 Knowledge Based Oil and Gas Industry Handelshøyskolen BI pp 2-123

[6] Jaeyoung Cho, Gino Lim, Taofeek Biobaku, Seonjin Kim and Hamid Parsaei 2016 Safety and Security Management with Unmanned Aerial Vehicle (UAV) in Oil and Gas Industry The Authors. Published by Elsevier BV pp 1344-1348

[7] Luis Onieva 2012 Organizational causes of accidents in manufacturing sector idUS 587-594

[8] Øyvind Dahl 2014 Behind Safety Violations: Understanding the antecedents of safety-compliant behaviour in the oil and gas industry NTNU-trykk pp 20-88

[9] Rita Marcella, Tracy Pirie and David Doig 2015 Tick safety not boxes: competency and compliance in the oil and gas industry Robert Gordon University pp 5-27