



# Environmental and Safety Issues in the Offshore Oil and Gas Industry

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### Mini Review

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## Abstract

Sources of danger in the petrochemical and gas extraction industry and aspects of life safety in general are determined. The article shows that the safety of life depends more on the human factor and oil the effect of the application of new technologies in gas extraction on the environment, including the field of labor protection and technical safety, was investigated. In this article, we have tried to find out about the specific risks of oil and gas production, especially the work carried out in the Caspian Sea. Also, measures to reduce specific risks that may occur during production and processing and general risk assessment have been reviewed. It should be noted that when assessing the risks associated with the production of offshore oil and gas fields in a given period, all oil companies should conduct a comprehensive assessment of the technical condition of the production facilities used, including taking into account specific risk assessment and environmental aspects. During the assessment, which should cover all potentially hazardous equipment, special attention should be paid to parameters such as the type of devices used, their actual age, maintenance history and natural human factors. It should be emphasized that at present the intensity of development of the petrochemical industry and gas production is characteristic of all Caspian countries (Azerbaijan, Turkmenistan, Kazakhstan, Russia and Iran).

**Keywords:** Technical Safety; Life Safety; Human Factor; Specific Risks; Risk Assessment

## Introduction

Environmental problems in the use of oil and gas resources are primarily associated with their extraction during production and the extraction of related components of the raw material during its processing; at the same time, the likelihood of accidents leading to injuries to personnel and significant economic losses increases [1-3]. Analysis of technogenic accidents and disasters shows that the presence of specially installed fire extinguishing equipment

in buildings where large volumes of flammable and explosive waste are produced is one of the factors preventing major tragedies. Special fire warning systems are used in this type of production.

## Materials and Methods

In order to prevent the possibility of accidents in the equipment and technological processes used in oil and gas production, external and internal potential sources

of accidents should be identified and eliminated. For this purpose, a register of information on accidents and even near-accidents should be created. Analysis and statistics of the causes of accidents in the oil and gas production and processing industries have shown that in recent years, 95% of these cases are mainly related to the explosion of various hazardous substances. 54% of these accidents occurred in technological devices and installations, and 46%, depending on the type of process, occur in working buildings and industrial areas. The spread of oil spilled at sea is subject to the processes of emulsion formation, evaporation, oxidation, sedimentation, biological decomposition and dispersion.

The accidents that have occurred in gas production in recent years are mainly due to:

- The large volume and speed of flammable and explosive substances transported in technological systems;
- The high temperature and pressure of the fire and explosion hazardous environment. The causes of explosions of steam-gas-air mixtures in devices, work zones and technological installations and their elimination should be analyzed in order to analyze all risks and conduct a specific risk assessment for a specific job. It is not correct to use a risk assessment for one process for another process. Because the sources and direction of danger may be unique for each process. Statistical data can affect the risk assessment.

However, statistics cannot be fully relied on in assessing the risk of hazardous processes. It is possible that there have been very few incidents in a hazardous process, but more serious incidents may occur in the future. In general, typical accidents in the oil and gas industry and their causes:

1. Low-risk accidents. Their cause: ignitions and burns occurring in technological installations that are not related to the presence of an explosive vapor-gas mixture not only in the apparatus, but also in the atmospheric air in the working zone.
2. Dangerous accidents. Their cause: explosions and severe fires occurring in open installations and working buildings due to the release of fire and explosive products into the atmosphere for any root cause.
3. Very dangerous accidents. Their cause: explosions occurring inside technological equipment and installations, during which, after the equipment is damaged, the flammable products released into the environment cause a second explosion or fire in the atmosphere. This type of accident is very dangerous and, due to its scale, can cover a large area.

Of course, everyone can see the consequences of accidents at first. However, the root causes of accidents may not be obvious. Statistics show that the role of the human factor in most accidents is very large.

Let us emphasize that the role of the Caspian Sea in the development of the petrochemical and gas industries has been very large. Back in history, in 1946, two large-block platforms were built for offshore drilling at the "Gorgan" field. This event could be considered the beginning of systematic and technologically advanced oil and gas exploration activities in the Caspian Sea. In 1949, a fountain erupted in oil rocks, which were considered rare deposits at that time, marking the beginning of a new stage of offshore oil production, and for the first time in the world, oil began to be extracted offshore.

On August 24, 1949, the development of the unique offshore field "Oil Rocks" (Neftyanie Kamni on Russian) on the Absheron shelf and the construction of steel offshore platforms began; on November 7, the first well was drilled in this field, from which a daily oil flow of 100 tons was obtained from a depth of 1,000 meters.

It should be noted that "Oil Rocks" are sometimes called "Seven Ship Islands", because 7 old ships were sunk to create a foundation for drilling the first wells, one of which was the famous ship "Zoroastrian", built in 1877 in Sweden (Motala) by order of Ludwig Nobel. The ship "Zarathusht" was the first oil tanker of the company owned by the "Nobel brothers" in the world [4].

The most important moment in the production of oil and gas in the Caspian Sea was the "Contract of the Century" developed by the brilliant politician Heydar Aliyev, signed on September 20, 1994. This contract, with the participation of 11 of the world's largest well-known oil companies, breathed new life into the oil and gas industry of modern Azerbaijan. Of course, with the arrival of these foreign companies to Azerbaijan, it brought modern technology to the petrochemical and gas industry, as well as safety and environmental standards applied in these areas. Considering the great risks in the process of offshore oil and gas production, this moment occupied a very important place.

Throughout history, oil and gas production in Azerbaijan has had a great impact on the environment. The issues of labor protection and technical safety of workers working in this sphere have always been relevant. Modern technology and proven international standards have served to minimize risks in the petrochemical and gas industry and create safer working conditions for workers. We should emphasize that today the main source of energy is hydrocarbon raw materials (oil and gas). The oil and gas industry are one of the leading economic sectors in Azerbaijan as well as in the world economy.

In general, the technogenic activity of people in the process of extraction, processing, transportation, storage

of hydrocarbons usually has a negative impact on the environment and people. Work related to the development and exploitation of oil and gas fields has a whole spectrum of such impacts. The scale of negative consequences depends on the stage of implementation and the scale of human activity; natural conditions in the area where it is carried out; the sensitivity of natural objects; as well as the effectiveness of measures to reduce environmental impacts and prevent pollution using control methods, taking into account the analysis of all existing risks [5,6]. Currently, oil and gas industry companies are exposed to the influence of the current economic situation in the world, and against the background of this pressure, additional risks have arisen. Almost all of the identified risks are of a certain nature. Their relative importance primarily depends on the current state of the economy and labor productivity.

For example, the accident on the BP oil platform “Deep Water Horizon” (DWH) in the Gulf of Mexico (April 2010) further aggravated the situation in the industry. Therefore, the most important element in the extraction of hydrocarbons on the shelf is also the organization and conduct of effective and high-quality monitoring of the state of the environment. The consequences of the large-scale environmental disaster that occurred in the Gulf of Mexico affected companies engaged in the exploration and production of hydrocarbons on the continental shelf not only in this region, but also far beyond its borders. Discussing the issues of response to the oil spill and liability will undoubtedly answer many questions related to the accident on the British oil platform “DWH”. The root causes of the accident in the Gulf of Mexico should be identified and thoroughly analyzed. In order to minimize the likelihood of such a disaster recurring, appropriate safety measures should be taken and a special risk assessment should be carried out.

## Discussion

It should be noted that when assessing the risks associated with the production of offshore oil and gas fields in a given period, all oil companies should conduct a comprehensive assessment of the technical condition of the production facilities used, including taking into account specific risk assessment and environmental aspects.

During the assessment, which should cover all potentially hazardous equipment, special attention should be paid to parameters such as the type of devices used, their actual age, maintenance history and natural human factors. It should be noted that the intensity of development of the petrochemical industry and gas production is characteristic of all Caspian littoral countries. For example, in Azerbaijan, according to the “Ministry of Energy of Azerbaijan”, by the end of 2022, a total of 25.2 billion cubic meters of natural gas was produced

from the “Shah Deniz” gas-condensate field, and the proven reserves of “Shah Deniz” are estimated at 1.2 trillion cubic meters of gas and 240 million tons of condensate. Recall that currently the Shah Deniz field is one of the largest natural gas fields in the world, its annual production is approaching 30 billion cubic meters, and a significant part of the produced gas goes to Europe through the Southern Gas Corridor (SGC).

According to SOCAR: Confirmed natural gas reserves in Azerbaijan are 2.6 trillion cubic meters, and according to forecasts, up to 6 trillion cubic meters.

Interesting facts (in 2024):

- On January 7, the SDX-8 exploration well in Azerbaijan’s Shah Deniz field reached a design depth of approximately 7,000 m (according to BP Azerbaijan). It was drilled using the Heydar Aliyev semi-submersible drilling rig. SDX-8 is one of the deepest exploration wells in the Caspian Sea.
- On January 20, BP, the operator of the Azeri-Chirag-Guneshli field development project, launched a new program of high-precision four-dimensional (4D) seismic exploration of seabed nodes in the field. This is the largest seismic acquisition project in the world by BP in all aspects - the size of the area, the cost and the duration of the program.
- On March 1, the 10th Ministerial Meeting of the SGC Advisory Council and the 2<sup>nd</sup> Ministerial Meeting of the Green Energy Advisory Council were held in Baku. These meetings highlighted the key element in diversifying gas supply sources in Europe.
- On 16 April, BP, as the operator of the Azeri-Chirag-Guneshli project, announced the start of oil production from the new Azeri-Central-East platform (drilling depth reached 3,150 m). According to BP, this platform is one of the most technologically and digitally advanced in the world.
- On June 21, as a result of cooperation, SOCAR and the Bulgarian companies “M-Gaz” and “Asarel Medet” started supplying natural gas to industrial enterprises in Bulgaria, which is an important step in strengthening the energy security of Bulgaria.
- On September 20, SOCAR and Hungarian MOL Hungarian Oil & Gas signed a memorandum of understanding “On exploration, development and production at the Shamakhy-Hobustan site”. The parties will cooperate on this project with the aim of further increasing hydrocarbon production in Azerbaijan.
- Within the framework of COP29 (Conference of Parties) on November 19 in Baku, a memorandum of understanding was signed between SOCAR Green and Power China for the study of joint opportunities in the development of renewable energy projects in Azerbaijan. Earlier, on November 11, the opening of the 29th session of the Conference of the Parties to the UN Framework Convention on Climate Change (COP29) was held at the

Olympic Stadium in Baku, which lasted until November 22.

- On December 6, the GL Group company started drilling the first horizontal well on onshore in the history of Azerbaijan, at a depth of 4400 m and a lateral shaft length of ~ 400 m.

Thus, it is clear that the increase in oil and gas production in the Caspian Sea increases the number of possible specific risks expected in the oil and gas industry.

## Conclusions

1. Environmental control over environmental pollution caused by intensive oil and gas production in the Caspian Sea is necessary. Moreover, accelerated oil and gas production is expected in the near future (until 2050). An increase in production volumes will certainly lead to an increase in the production volumes of oil and gas processing and the chemical industry in general. In this regard, environmental problems and safety of life should be the main issue for all companies operating in the Absheron Peninsula, where the petrochemical and gas industry is most located, and in the Caspian basin, where most oil and gas production is carried out.
2. The operation of offshore oil and gas installations carries significant dangers, which should be minimized as much as possible due to their specific risks. In order to minimize risks, this process can be carried out by introducing new techniques and technologies, as well as by creating a qualified personnel reserve.
3. Considering that the fire and explosion hazardous oil and gas processing and chemical industry enterprises, most of which are located on the Absheron Peninsula, are not far from residential areas, we consider that even more serious measures should be taken from the ecological

and life safety aspects.

4. If we turn to history, the primary cause of any man-made accidents is the human factor. In addition to learning from the man-made accidents in the history of the oil and gas and chemical industries, we must minimize the risks that arise. However, experience has shown that even with the most modern production technology, the risk is never zero.

## References

1. Mirbabayev MF, Kerimov FM, Uzeirli UC (2023) Environmental problems and safety of life activity in the petrochemical industry and gas extraction. Proceedings of the VIII Republic scientific and technical conference on the topic "Advanced technologies and innovations". Azerbaijan Technical University, Baku, pp: 702-706.
2. Mirbabayev MF, Yusubov FV, (2022) Energy strategy and ecology of oil and gas production in the Caspian Sea, Scientific Herald. The Academy of the Ministry of Emergency Situations, pp: 32-36.
3. Mirbabayev MF (2023) Chemistry of oil and layer waters; the impact of their composition on the ecology of the Caspian Sea, Scientific Herald. The Academy of the Ministry of Emergency Situations, 2: 6-11.
4. Mirbabayev MF (2022) Oil Rocks: Early offshore production from the Caspian City in the sea. AAPG Explorer, USA, pp: 18-20.
5. Kuznetsova TO, Varavina EP (2015) Environmental safety in the oil and gas industry. NTU Kharkov Polytechnic Institute, Kharkov.
6. Mirbabayev MF (2022) Hydrocarbon production and energy security in the Caspian region. Energies Net.