

ANALYSIS OF THE STATE OF OCCUPATIONAL SAFETY IN THE OIL AND GAS INDUSTRY AND THE ROLE OF THE HUMAN FACTOR

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Annotation. This paper examines in detail the state of industrial safety and mechanisms for ensuring it in the oil and gas and fuel and energy complex of Kazakhstan. It is determined that the level of security of production activities is the most important indicator of the economic and social development of the state, and the main directions of Industry Improvement are analyzed. The fact that the main causes of accidents in oil and gas production are corrosion, gas and oil manifestations that occur during drilling wells, and the human factor, is substantiated by statistical data. The importance of technical and technological measures, such as reducing corrosion of pipelines and commercial equipment, the introduction of modern diagnostics and monitoring systems, is revealed. In addition, the organizational aspects of industrial safety management, the need to develop technical regulations, and the stages of formation of the state management system in the field of labor protection will be outlined. As a result of the work, the relevance of the implementation of an effective management system based on preventive measures to increase the level of industrial safety is demonstrated.

In addition, the study also considers the possibilities of adapting international practices to domestic conditions, approaches to early detection of threats using digital technologies and the importance of improving the professional training of personnel. It is shown that these areas contribute to the formation of a stable and safe production environment in the oil and gas industry.

Keywords: industrial safety, oil and gas industry, causes of accidents, corrosion, production control, technical regulations, labor protection, safety management.

Introduction. The level of industrial safety is one of the most important indicators of the economic development of the state, social stability and moral culture of society. Compliance with safety requirements, especially in such strategically important areas as the oil and gas and fuel and energy complex, is directly related to the security of the state, the efficient use of Natural Resources and the well-being of the population.

In the development of the oil and gas sector of Kazakhstan, the main tasks are the development of new fields, the extraction of hydrocarbons from deep layers, increasing production volumes and improving production efficiency. However, the implementation of these tasks requires the use of safe technologies, improvement of drilling methods, strengthening of anti-corrosion measures and ensuring reliable operation in pipeline systems. Statistical data show that most of the emergency situations of the industry are based on such reasons as corrosion, gas-oil manifestations during well drilling and the human factor [1].

To ensure industrial safety, an important role is played by improving the system of technical regulation, clarifying safety requirements, organizing production control and improving the qualifications and culture of employees. At the same time, the introduction of systems based on the prevention direction of safety management will effectively reduce risks at hazardous production facilities [2].

In this paper, topical issues of the safety situation in the oil and gas industry, the reasons for their occurrence, technical and organizational measures, as well as the formation of the state labor protection management system in Kazakhstan are considered in detail.

Research materials and methods: the state of safety of production activities is the most representative and reliable indicator of the level of economic and social development of the state, the moral state of society [3-6].

The main directions of development of the fuel and energy complex of Kazakhstan were defined as the main tasks of the industry: increasing the pace and efficiency of economic development based on the acceleration of scientific and technological progress, Technical re-equipment and reconstruction of production, intensive use of production potential, improvement of the management system. At the same time, it is planned to ensure the production of a sufficient amount of oil, gas and gas condensate due to the development of the industry by introducing a large number of new oil and gas fields into development, including the introduction of deep-lying fields into development, which means improving well drilling technologies and reducing the number of gas and oil manifestations (in the total balance of accidents over the past five years, this category averages about 40% -%) Achieving reliable and safe operation of professional pipeline systems is possible by solving two main problems [5]:

- reduction or prevention of corrosion of oilfield equipment and pipelines of various purposes due to the use of technological methods aimed at maintaining the initial low aggressiveness of manufactured products and the use of special protective equipment (this factor is 7090% -0 of accidents on field pipelines);

- improving the effectiveness of organizational and technical measures (diagnostics, monitoring, repair, etc.).

For objects of main hydrocarbon transport, it is necessary to conduct regular technological and environmental monitoring using Geoinformation systems for quantitative and qualitative monitoring and analysis of the state of the pipeline, as well as use modern remote methods to search for leaks.

Domestic practice, developed in the pre-market era, is based on state regulation. Conceptually, this law is based on European principles of technical regulation. In particular, the law establishes that mandatory security requirements are established by law-in the form of technical regulations.

Therefore, the first stage of work on the creation of technical regulations should be an analysis of industrial safety requirements in order to form lists of mandatory and optional (of a recommendatory nature) requirements for objects of technical regulation. At the same time, it seems very important to take into account the specifics of industrial safety requirements, which, in contrast to the requirements of technical regulations, are often not technical, but organizational (for example, requirements for the qualifications and qualifications of employees). The importance of the latter is evidenced by statistical data on the causes of accidents and injuries at hazardous production facilities in the oil and gas industry. The first and most important is the human factor (non - compliance with production discipline, violation of the rules of industrial safety and labor protection, job descriptions, rules of labor discipline, etc.). The second is the inattention of the heads of enterprises to labor protection issues. The third is the aging of equipment, which leads to an increase in the incidence of accidents. Thus, the main cause of a high industrial accident is not related to the characteristics of products and processes, but to the actions of people[6-7].

Results and discussion: preventive measures have been taken to improve the effectiveness of security management. In particular, each organization operating a hazardous production facility should develop and implement an industrial safety management system, while the production control system should be an integral part of the industrial safety management system. Within the framework of such a system, the rights and responsibilities of employees in the field of industrial safety should be clearly defined, effective production control should be organized, information and analysis should be provided for making optimal and timely decisions on the elimination or reduction of risk factors at the level of the organization's management.

In the recent history of Kazakhstan, two stages of the formation of the system of state management of labor protection have passed. The formation of a system of state management of labor protection in the country was accompanied by the creation of a regulatory legal framework for labor protection at the federal level and in the regions. More than 50 subjects of the Republic of Kazakhstan have adopted their own laws on labor protection, which provide for the powers of

executive authorities in this area and the powers of local self-government bodies. Organizations form their own labor protection management systems aimed at implementing the triad [8-9].

As a rule, the economic damage in the development of oil fields is significantly higher than in the development of coastal fields, which mainly contributed to the significant improvement and improvement of the methods of management of HSE and HSE during oil production and transportation of hydrocarbons.

The main trend in improving approaches to ensuring industrial safety and labor protection in comparison with the methods used in the management system is the transition from the activity of pure control (supervision) of compliance with specific safety requirements to regulatory methods of state supervision based on the updated regulatory framework and licensing activities. It should be noted that the effectiveness of regulatory methods of state supervision is largely determined by the models and mechanisms used in the management of SB and HSE. A distinctive feature of the risk assessment-based surveillance system is the practically complete assignment of responsibility to the organization for compliance with the requirements of the IP and the IP, which makes it possible to solve the problems of the IP and more fully involve its tools and personnel potential, develop the motivational component of the implementation of safety standards. In turn, the management of the organization is responsible for the state of labor protection and must ensure the development, implementation and functioning of the labor protection management system in accordance with the established requirements [9].

The introduction of a system of state supervision based on risk assessment in Kazakhstan should be carried out in stages, solving the following tasks [3-6]:

1. development of legislation aimed at creating a flexible tax policy designed to improve the state of the PP and HSE, stimulate employers' responsibility for the efficiency of the production sector and the protection of workers' health; Deviations of this or that kind have found their expression, since, first of all, the necessary level of security of the object is given and ways to achieve this level are formulated;

- development of modern approaches to management of OP and HSE, including improving internal control systems in organizations operating hazardous production facilities;

2. development of measures to introduce modern safe production technologies in accordance with the needs of the reformed industries and international norms and requirements, improve the state of the PP and HSE;

3. Improving approaches to social insurance at work, taking into account the classes of working conditions, the level of Occupational morbidity and injuries.

The implementation of these tasks is ensured through the use of appropriate economic and organizational mechanisms. In order to form the economic interest of employers in improving the quality of the production environment, it is necessary to concentrate efforts in the following areas:

- * development of mechanisms that contribute to increasing the motivation of employers to create safe working conditions with legislative strengthening of measures of responsibility for labor protection;

- * conducting an examination of working conditions;

- * improvement of the system of compulsory social insurance against industrial accidents and occupational diseases.

Among other activities, the creation of the Kazakhstan Labor Protection Information Center, the main functions of which should be monitoring and analyzing the state of working conditions; the creation of a register of jobs by working conditions, including those with harmful and (or) dangerous working conditions; the introduction of a personalized health passport (occupational labor route map, occupational morbidity index and Dr.); certification of workplaces for working conditions, creation of basic Regional Centers for occupational risk management for training and retraining of employees in connection with occupational risk in order to prevent the risk of occupational diseases; creation of a unified information system for accounting and control of occupational accidents and occupational diseases; formation of a National Register of occupational diseases and disability as a result of occupational diseases; Creation of an atlas of professions used

for the employment of victims of industrial accidents, occupational diseases and employees with a high degree of occupational risk; conducting inspections and predictive research, providing advisory and legal assistance to employers and citizens on labor protection issues, promoting labor protection [10].

Information and analytical support allows you to monitor the situation with labor protection in the country and regions, creating a kind of "feedback" between the managerial impressions of the bodies included in the state system of labor protection management and the actual state of affairs with industrial injuries, occupational diseases, working conditions at the country's enterprises. It is necessary to take measures to improve the organization and methodological support of labor protection training, in particular [11-13]:

- * creation and updating of educational information resources (teaching aids, posters, methodological materials, electronic library);

- * improvement of the material and technical base (computer equipment, mannequins-simulators for the provision of medical care, laboratory instruments and complexes, exhibits and samples of personal protective equipment, etc.).

In order to promote labor protection, it is necessary to develop topics and methods for transmitting campaign materials in the mass media and on the Internet.

These measures, on the one hand, should be aimed at maintaining a certain level of PSA and HSE, and on the other hand, should not interfere with the production of the required number of products and services. The final choice of measures should be preceded by an analysis of the effectiveness of their implementation, which will make it possible to determine the principles of selecting organizational, technical and economic solutions that reduce the likelihood of injuries and accidents in wells, oil and gas field training facilities, pipelines. The paper presents the concept of justifying the effectiveness of measures that increase the level of safety of oil and gas industries. The purpose of the concept is to ensure an acceptable level of safety of production processes by increasing efficiency and reducing the costs of technogenic risk management methods and tools. As a criterion for the effectiveness of methods for reducing man-made risks, the minimum amount of the parameter calculated for several types of activities or their complexes and expressing the amount of all costs necessary for the implementation of the activities and the mathematical expectation of damage characterizing these activities was taken [13-18].

It should be noted that the permissible level of security is largely determined by the level of development of society. It is this level of development that limits the possibilities of using economic and organizational mechanisms. Indeed, the effectiveness of the use of mechanisms directly depends on the price that society is willing to pay for its own safety. The higher the assessment of the risk of an emergency, the greater the amount of economic impact of eliminating the possibility of an accident.

The human factor is a multifaceted concept, including the quality of professional training of an employee, his moral and psychological state and personal qualities. Management of an organized social system in production, that is, in other words, Personnel Management, in which the human factor plays an important role, leads to significant progress in creating a safety culture and reducing accidents and injuries. However, management is primarily a psychological process. Accordingly, the professionalism of managers, the quality and effectiveness of management depend on taking into account the state of people and using a subtle psychological management tool. Turning to international experience, it should be noted that at present the role of managers in ensuring safety at work is well known. Accordingly, data from different industries make it possible to identify five main factors affecting the state of PB and ot in production:

- 1) general management of Works and control over their implementation (the role of managers)

- 2) Functioning Of The Supbiot

- 3) risks (including risks related to the behavior of personnel)

- 4) schedule of work

- 5) staff competence

It should be noted that there is no individual factor in this classification, but, according to the author, it is determined by factors 1 (the role of leaders) and 5 (the competence of personnel). In addition, the number of studies describing the role of organization leaders (or senior managers) and their impact on safety at work has been limited until recently. In turn, the UK Occupational Safety Regulations (1999) [85] identify the following organizational factors that affect the safety situation at work:

- * Commitment of senior managers to the principles of Occupational Safety
- * Style and behavior of leaders
- * Visibility (transparency) control
- * Communication between personnel at different levels (activities of managers)
- * Balance between labor safety goals and production goals (priority of managers)

It can be seen that recently the decisive role in ensuring safety in production has been assigned to managers, and attention is paid not only to the Masters who manage production processes at the workplace, but also to the management of enterprises.

In general, a decrease in the level of Occupational Injuries can be achieved on the basis of the adherence of management to the principles of ensuring safety and the targeted policy of the enterprise, where one of the key elements is a high-quality professional system for the preparation and formation of appropriate socio-psychological motivation.

Of course, in order to prevent accidents, it is necessary to understand why they happen and what causes them. Below are the most popular theories about the occurrence and Prevention of accidents in world practice. Consideration of theoretical aspects will allow not only to identify in detail the causes of accidents and injuries, but also to clearly identify factors affecting Occupational Safety in the future, which, in turn, will help to develop effective methods for improving the state of PB and fire at work.

In principle, such theories are used as models to predict and prevent accidents that are defined as unplanned events that lead to injury, death, loss of production or damage to property. Obviously, the development of effective preventive measures aimed at preventing accidents is very difficult when we do not understand the real causes of accidents and injuries. Many attempts to develop the only correct theory of the occurrence of an accident have not yet been successful, so so far no theory is universal.

However, the author believes that it is necessary to consider the most popular theories, since this will ultimately help to develop effective tools for managing PB and ot at the enterprises of the oil and gas industry.

One of the first theories of the origin of accidents was the "domino theory" of X.created by V. Heinrich in 1931. According to this theory, 88% of accidents are due to dangerous actions of people, 10% are due to the operation of machines and mechanisms and 2% is due to "force majeure". Heinrich proposed five factors for the occurrence of accidents, where each factor triggers the next, which is similar to the effect of falling dominoes.

The sequence of factors for the occurrence of accidents is as follows:

1) Origin and social environment of the employee. This category includes the personal qualities of the employee, which ultimately leads to an error. Such traits are negative, such as stubbornness or carelessness, and can be inherited or acquired in a certain negative social environment.

2) employee error. Heinrich immediately argues that an employee's mistake is characterized by certain congenital or acquired defects, such as irritability, indifference, ignorance, and character traits of the employee, which are formed mainly in the family, lead to dangerous actions at work, and unfavorable life situations form dangerous situations.

3) dangerous actions or situations. This" domino "is a special combination of previous factors and explains the direct causes of the occurrence of accidents. Dangerous actions include, for example, driving a car without a preliminary inspection, and dangerous ones include the absence of a railing on the stairs. Heinrich highlights four reasons why people commit dangerous acts:" unfair treatment of the case", " lack of knowledge or skills", "physical unsuitability"and"mechanisms and

working conditions that do not correspond to the nature of its performance". Later, he divided the causes into direct and indirect. For example, an employee who has specially committed dangerous actions can do this due to lack of confidence in the need to take any preventive measures, as well as due to the lack of supervision of a supervisor. Later, Heinrich added "Recent" or recent events-causes-to direct and indirect causes. A combination of such causes creates a systematic time sequence of events that lead to a catastrophe.

4) accident. Accidents refer to an action that leads to injury or property damage to an employee.

5) damage or injury. Injury is the result of an accident, typical injuries of Heinrich are cuts, fractures.

So, a consistent sequence of factors leads to an injury in production - the "Domino principle". However, if one of the links in the chain is destroyed, the fall of the remaining dominoes will be interrupted, helping to avoid an accident. One of the main reasons for working and solving is in the middle of the domino chain - "dangerous actions or situations."

According to Domino's theory, the responsibility for injury lies primarily with the employer, so the head of the PB and ot Department must deal with non-compliance with the principles of Occupational Safety through direct supervision, training employees in safe working methods and maintaining discipline, thereby eliminating "dangerous actions and situations". Although Heinrich did not present facts that actually supported his theory, his theory was the impetus for the development of subsequent more advanced studies.

The domino theory is unique, only because it existed practically unchanged from 1929 to 1994.

The technical methods introduced by Heinrich in 1931 are still used today for various PB and ot control systems. Such technical methods include careful monitoring; development and compliance with the rules of the PSA and HSE; training of personnel using visual materials, including videos; identification of production risks by analyzing existing experience; verification of the state of working conditions; audit of enterprises; investigation of accidents; analysis of Work Production; collection of materials and preparation of reports on the investigation of accidents; the process of approving new construction and installing new equipment; developing and agreeing on changes in work procedures or processes; action plan in emergency situations; providing first aid.

Conclusion: Heinrich proposed to use the level of accidents with loss of working time as the most appropriate measure to measure the effectiveness of industrial safety conditions. The basis of Heinrich's philosophy of accident prevention was an axiom - "dangerous actions of people are the cause of most accidents, it is necessary to control the actions of personnel, safety should be managed like any other component of a successful business."

To ensure occupational safety in the oil and gas industry, it is important to improve protective equipment, constantly monitor their quality and introduce modern technologies. At the same time, strengthening the professional training of specialists, the formation of a culture of responsibility and safety will significantly contribute to the Prevention of accidents at work, protecting the life and health of employees, and improving production efficiency as a whole.

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МҰНАЙ-ГАЗ САЛАСЫНДАҒЫ ЕҢБЕК ҚАУІПСІЗДІГІ ЖАҒДАЙЫН ТАЛДАУ ЖӘНЕ АДАМ ФАКТОРЫНЫҢ РӨЛІ

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Аңдатпа. Бұл жұмыста Қазақстанның мұнай-газ және отын-энергетикалық кешеніндегі өндірістік қауіпсіздік жағдайы мен оны қамтамасыз ету тетіктері жан-жақты қарастырылады. Өндірістік қызметтің қауіпсіздік деңгейі мемлекеттің экономикалық және әлеуметтік дамуының маңызды көрсеткіші екені айқындалып, саланы жетілдірудің негізгі бағыттары талданады. Мұнай-газ өндірісіндегі авариялардың негізгі себептері – коррозия, ұңғымаларды бұрғылау кезінде орын алатын газ-мұнай көріністері және адами фактор екендігі статистикалық деректермен негізделеді. Құбырлар мен кәсіпшілік жабдықтардың коррозиясын төмендету, заманауи диагностика және мониторинг жүйелерін енгізу сияқты техникалық және технологиялық шаралардың маңызы ашылған. Сонымен қатар, өнеркәсіптік қауіпсіздікті басқарудың ұйымдастырушылық қырлары, техникалық регламенттерді әзірлеу қажеттілігі, еңбекті қорғау саласындағы мемлекеттік басқару жүйесінің қалыптасу кезеңдері баяндалады. Жұмыстың нәтижесінде өнеркәсіптік қауіпсіздік деңгейін арттыру үшін алдын алу шараларына негізделген тиімді басқару жүйесін енгізудің өзектілігі көрсетіледі.

Қоса алғанда, зерттеуде халықаралық тәжірибелерді отандық жағдайға бейімдеу мүмкіндіктері, цифрлық технологияларды қолдану арқылы қауіп-қатерлерді ерте анықтау тәсілдері және персоналдың кәсіби даярлығын жетілдірудің маңыздылығы да қарастырылады. Бұл бағыттар мұнай-газ саласындағы тұрақты әрі қауіпсіз өндірістік ортаны қалыптастыруға ықпал ететіні көрсетіледі.

Тірек сөздер: өнеркәсіптік қауіпсіздік, мұнай-газ саласы, авария себептері, коррозия, өндірістік бақылау, техникалық регламент, еңбекті қорғау, қауіпсіздік менеджменті.

АНАЛИЗ СОСТОЯНИЯ ОХРАНЫ ТРУДА В НЕФТЕГАЗОВОЙ ОТРАСЛИ И РОЛИ ЧЕЛОВЕЧЕСКОГО ФАКТОРА

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Аннотация. В данной работе комплексно рассматривается состояние промышленной безопасности в нефтегазовом и топливно-энергетическом комплексах Казахстана и механизмы ее обеспечения. Определено, что уровень безопасности производственной деятельности является важным показателем экономического и социального развития государства, и проанализированы основные направления совершенствования отрасли. Основными причинами аварий в нефтегазодобыче являются коррозия, газонефтяные явления, возникающие при бурении скважин, и человеческий фактор, что обосновано статистическими данными. Раскрывается важность технических и технологических мероприятий, таких как снижение коррозии трубопроводов и промышленного оборудования, внедрение современных систем диагностики и мониторинга. Кроме того, описываются организационные аспекты управления промышленной безопасностью, необходимость разработки технических регламентов, этапы формирования государственной системы управления в области охраны труда. Результаты работы показывают актуальность внедрения эффективной системы управления, основанной на превентивных мерах, для повышения уровня промышленной безопасности.

Кроме того, в исследовании рассматриваются возможности адаптации международного опыта к отечественным условиям, методы раннего выявления рисков с использованием цифровых технологий, а также важность совершенствования подготовки кадров. Показано, что данные направления способствуют формированию стабильной и безопасной производственной среды в нефтегазовой отрасли.

Ключевые слова: промышленная безопасность, нефтегазовая отрасль, причины аварий, коррозия, производственный контроль, технический регламент, охрана труда, управление безопасностью.