UDC 614.8:622(04) https://doi.org/10.23947/2541-9129-2021-1-21-25

Training modules in the formation of risk-based thinking of employees in oil industry

R. O. Shadrin, B. V. Sevastyanov
Kalashnikov Izhevsk State Technical University (Izhevsk, Russian Federation)

Introduction. The relevance of the presented work is, first of all, due to the significant number of employees of oil companies. There are more than a million of such specialists working in Russia. At the same time, world statistics claim that more than a third of critical deviations in the health indicators of workers are associated with harmful production factors. In order to avoid the relevant risks, it is important, in particular, to organize productive training in labor safety standards and rules, and to form risk-oriented thinking.
Problem Statement. The conducted research is aimed, first, at identifying typical occupational risks in the field of oil production. The Standard Regulation on the Occupational Health and Safety Management System developed by the Ministry of Labor of the Russian Federation is used as the basis for classification. Secondly, the features of modular training in labor safety standards and rules, taking into account the risks in the workplace, are justified.
Theoretical Part. The regulatory and legal framework of labor protection, including enterprises with high accident risks, is considered. The paper provides key professions and main labor functions taking into account the production practices of two oil-producing enterprises operating in Russia. The analysis of actual workplaces and regulatory documents allowed us to establish typical occupational risks for the specialties under consideration. The recommendations for improving the system of training in labor safety standards and rules are proposed.
Conclusion. Occupational risks are identified from the list of hazards presented in the Standard Regulation on the Occupational Health and Safety Management System. The recommendations for the implementation of the identified occupational risks in the system of training in occupational safety standards and rules are proposed. With this information, you can reduce the time spent on identifying occupational risks in oil production, which generally optimizes the risk management of this field.

Keywords: occupational safety, occupational risks, oil production, occupational risk management, training in occupational safety standards and rules.

***For citation*:** Shadrin R. O., Sevastyanov B. V. Training modules in the formation of risk-based thinking of employees of oil industry: Safety of Technogenic and Natural Systems. 2021;1:21-25. https://doi.org/10.23947/2541-9129-2021-1-21-25

***Funding*:** The study was carried out with the financial support of the Kalashnikov IzhSTU within the framework of the scientific project No. SHRO/20-86-11.

Introduction. According to the UN, accidents at work and occupational diseases cause the death of more than 2 million people a year [1]. At the same time, more than a third of critical deviations in the health indicators of workers are caused by harmful production factors [1]. The monitoring conducted at the beginning of the XXI century showed that the total number of injured people in the world exceeded 300 million [1].

Oil-production enterprises are located throughout the country, and the number of employees, including service organizations, exceeds one million. All this has led to the relevance of comprehensive research aimed at identifying occupational risks and their relationship to technological processes.

To prevent the implementation of occupational risks, training in occupational safety standards and rules is important. Technical measures can reduce, but not eliminate, the potential danger of the equipment used. In this case, the key control element will be the appropriate training of employees and specialists in the field of occupational risks and occupational safety. This approach can be called the formation of risk-based thinking.

Problem Statement. An important place in the production activities management is occupied by the professional risks management. The register containing the identified professional risks of employees is one of the local regulations of the organization that are subject to verification in the field of professional risk management[2].

[1] World Health Statistics 2020 : monitoring health for the SDGs, sustainable developments goals / United Nations. URL: https://www.who.int/data/gho/publications/world-health-statistics (Accessed 15th January 2021).
[2] Ob utverzhdenii Metodicheskikh rekomendatsiy po proverke sozdaniya i obespecheniya funktsionirovaniya sistemy upravleniya okhranoy truda. Prikaz Rostruda ot 21.03.2019 No. 77. Ministerstvo truda i sotsial'noy zashchity Rossiyskoy Federatsii; Federal'naya sluzhba po trudu i zanyatosti [On the approval of Methodological recommendations for checking the creation and operation of the labor protection management system. Order of

The objectives of the presented work are to identify typical occupational risks in oil production, taking into account the Model Regulations[3] published by the Ministry of Labor, and to develop proposals for improving the organization of training in labor safety standards and rules.

Theoretical Part. Identification of typical professional risks for people engaged in oil production was carried out at two enterprises: AO Belkamneft named after A. A. Volkov and Udmurtneft OAO.

Let us look at the key professions and the functionality of specialists working in this area.

— The oil and gas production operator maintains and ensures the smooth operation of the surface equipment of wells. His responsibilities also include the operation of automation that measures the parameters of the technological process and sampling [2].

— The operator of the desalting and dewatering plant controls the parameters of the technological process (temperature, pressure, flow), procedures for reducing the concentration of salts and water in oil, and is responsible for the operation of pumping, safety and heating equipment [3].

— The operator of the oil and gas production control panel provides start-up and shutdown of installations and mechanisms, information support and management of operators' work.

— The chemical analysis laboratory assistant uses chemical analysis methods to determine the current parameters of oil quality (composition, balance of chemical elements, impurities and compounds) [4, 5].

— The commodity operator controls the serviceability of the equipment of commodity and tank parks, level measurement and sampling of oil from tanks.

— The driller of workover of wells is responsible for capital repairs of wells with the use of special equipment [6, 7].

The classification of typical professional risks in the field of oil production is based on the nature of the impact source:

— mechanical hazards,
— electric danger,
— thermal danger,
— microclimate and climate,
— chemical factors,
— noise,
— vibration,
— aerosols (mainly fibrogenic),
— biological factor,
— physical overload and intensity of labor,
— impact of light,
— impact of plants,
— organizational shortcomings,
— fire,
— explosion,
— PPE,
— collapse,
— transport.

The identified typical occupational risks in oil production are described in more detail in [8].

Rostrud No. 77 of 21.03.2019. Ministry of Labor and Social Protection of the Russian Federation; Federal Service for Labor and Employment]. Available from: http://www.consultant.ru/document/cons_doc_LAW_322223/2ff7a8c72de3994f30496a0ccbb1ddafdaddf518/ (Accessed 16th January 2021).

[3] Ob utverzhdenii Tipovogo polozheniya o sisteme upravleniya okhranoy truda. Prikaz Mintruda Rossii ot 19.08.2016 No. 438n. Ministerstvo truda i sotsial'noy zashchity Rossiiskoy Federatsii [On the approval of the Model Regulation on the labor protection management system. Order of the Ministry of Labor of the Russian Federation No. 438n of 19.08.2016. Ministry of Labor and Social Protection of the Russian Federation]. Available from: https://mintrud.gov.ru/docs/mintrud/orders/541 (Accessed 16th January 2021).

The development of risk-oriented thinking of employees contributes to the reduction of the probability of professional risk realization. To do this, it is necessary to increase the effectiveness of training in labor safety standards and rules.

In such trainings, the activities related to risk management are modeled. This forms the basis for implementation of a process approach to risk accounting. Training materials created in the context of a risk-based approach should take into account the potential frequency and risk of hazards to the enterprise. When developing the risk register, the method of group expert assessments was used, which is traditionally a method of analyzing poorly formalized problems.

When selecting experts (all of them worked at the enterprises under study), their individual characteristics were taken into account: competence, creativity, attitude to expertise and constructive thinking. The expert group consisted of 7 people, including leading specialists of the labor protection department and managers of different levels. The expert assessment of the main risks was carried out using a questionnaire. The questionnaire consisted of 11 closed-type questions. The survey of experts allowed us to compile a risk register, which became the basis for the creation and implementation of a risk-based training program for employees of the enterprise.

The training was based on the Kolb's model (or cycle). This approach is based on the employee's work experience, so it is applied to adults who have professional experience.

The training program is proposed to be divided into relatively small modules, each of which would include 7-9 didactic units that are optimal for mastering. The training module should include theory, normative materials, and, if possible, visual and video materials. Typical occupational risks should be linked to the topic of the module.

As a rule, occupational safety is taught to adults, for whom training is not the main activity. This explains the special role of feedback with the audience.

At the first stage, the employee studies the theoretical material of the module. At the same time, it is important to use visual aids (including videos) that specify the theory and link it to the real work. In addition, the training should be based on their own practical experience, updating the production discourse.

The second stage is control. Two types of tests should be used here. Recent pedagogical studies confirm that it is not advisable to test a student more than twice. Students receive verbal support in the form of test tasks, so they are more willing to ask questions and work through difficult moments. Due to such communication, the teacher determines the level of mastering the material and fills in the information gaps.

When forming a bank of test tasks, it is necessary to focus on the taxonomy of Bloom's goals. The original goal taxonomy identifies 5 mental actions. Of these, knowledge comes first, and understanding comes second as a way to transform material from one form of expression to another. It is fundamentally important that the educational material is perceived at the level of understanding. This is what the tests should determine. We believe that it is inappropriate to require presentation of the material (level of knowledge) in such an audience.

Test number two completes the training cycle based on the materials of the module. In 98% of cases, students receive a positive rating on it, and this proves the effectiveness of the modular technology.

It should be noted that the identification of hazards in real workplaces gives more significant results in terms of reducing the likelihood of occupational risks. In this case, the typical occupational risks will serve as the basis for the formation of registers of identified occupational risks. Their inclusion in the training modules will contribute to a more active and effective formation of risk-based thinking.

Conclusion. Labor protection as a system of norms and measures is designed to regulate labor activity taking into account harmful and dangerous industrial factors, to ensure the reduction of the level of industrial injuries and the likelihood of emergencies. Workers engaged in oil production are affected by a large number of harmful factors. These are, for example, noise, vibration, high physical and psychoemotional loads. Among the dangerous factors, high-pressure equipment, explosive and flammable substances should be mentioned first of all [9].

To reduce the number of occupational injuries (accidents) and occupational diseases, a set of measures is needed, one of which is the assessment of occupational risks in the workplace. Within the framework of the presented study, the relevant procedures were carried out in relation to personnel employed in oil production, taking into account

the Standard Provision[4] of the Ministry of Labor. Using the obtained data, it is possible to reduce the time spent on identifying professional risks in oil production, which generally optimizes the risk management of this area.

The modular system of training in occupational safety standards and rules will contribute to the formation of risk-based thinking of employees in this field. The optimal volume of the module is 7-9 didactic units. The identified occupational risks should be included in each module based on a classification based on the nature of the risk. This presentation of the theory will be relevant to specific occupational risks in the workplace.

References

1. Borisov N. A., Pashkov A. N., Shvedov G. I. Vliyanie neblagopriyatnykh proizvodstvennykh faktorov na zdorov'e rabotayushchikh / [Influence of unfavourable working factors on the health of employees]. Proceedings of Voronezh State University. Series: Chemistry. Biology. Pharmacy. 2005;1:84–86 (In Russ.).

2. Senina V. I., Mishanin S. V. Otsenka professional'nykh riskov operatorov po dobyche nefti i gaza burovoy ploshchadki neftedobyvayushchey kompanii [Assessment of professional risks of oil and gas drilling site operators of an oil-producing company]. Dal'nevostochnaya vesna — 2016: mat-ly 14-i mezhdunar. nauch.-prakt. konf. po problemam ekologii i bezopasnosti [Far Eastern Spring-2016: proceedings of the 14th International Scientific and Practical Conference on Ecology and Safety Problems]. Komsomolsk-on-Amur: Publishing house of KnAGTU, 2016. p. 188–189 (In Russ.).

3. Samoylova M. I. Operator obezvozhivayushchey i obessolivayushchey ustanovki [Dewatering and desalting plant operator]. Tyumen: TyumGNGU, 2010. 251 p. (In Russ.).

4. Gugnina O. A., Korolev A. S. Analiz vrednykh proizvodstvennykh faktorov rabochego mesta laboranta khimicheskogo analiza [Analysis of harmful production factors of the workplace of a chemical analysis laboratory assistant]. Materialy nauchno-prakticheskoy konferentsii, posvyashchennoy 35-letiyu Orenburgskogo filiala RGU nefti i gaza (NIU) imeni I. M. Gubkina [Proceedings of the scientific and practical conference dedicated to the 35th anniversary of the Orenburg Branch of the Gubkin Russian State University of Oil and Gas]. Orenburg: Arnit, 2020. p. 541–544 (In Russ.).

5. Gubaydullina A. R., Fedosova A. V., Sharipova A. V. Organizatsiya rabochego mesta laboranta khimicheskogo analiza v ispytatel'noy laboratorii [rganization of Workplace of Chemical Analysis Laboratory Assistant in Testing Laboratory]. Life Safety. 2018;9(213):3–6 (In Russ.).

6. Skripnik I. L. Analiz usloviy truda buril'shchika kapital'nogo remonta skvazhin i razrabotka rekomendatsiy po ikh uluchsheniyu [Analysis of the working conditions of the driller of major workover and development of recommendations for their improvement]. Nedelya nauki SPBPU: mat-ly nauch. konf. s mezhdunar. uchastiem [SPbPU Science week: Proc. of sci. conf. with intern. participation]. Sankt-Petersburg: Politekh-press, 2018. p. 47–49 (In Russ.).

7. Tarasov V. N., Chelnokova N. V., Tarasova V. A. Vozmozhnye faktory riska u rabochikh pri burenii, dobyche i pererabotke prirodnogo gaza s vysokim soderzhaniem serovodoroda [Possible risk factors for workers in the drilling, production and processing of natural gas with a high content of hydrogen sulfide]. Advances in current natural sciences. Astrakhan: Akademiya estestvoznaniya, 2007;10:110–133 (In Russ.).

8. Russkikh N. A., Sevastyanov B. V., Shadrin R. O. Razrabotka tipovogo reestra identifitsirovannykh opasnostey dlya operatora dobychi nefti i gaza [Development of a standard register of identified hazards for an oil and gas production operator]. Tekhnosfernaya bezopasnost' v XXI veke: mat-ly X Vseros. nauch.-prakt. konf. magistrantov, aspirantov i molodykh uchenykh [Technosphere safety in the XXI Century: proceedings of the X All-Russian Scientific and Practical Conference of Undergraduates, Postgraduates and Young Scientists]. Irkutsk: IRNITU Publishing house, 2020. p. 102–109 (In Russ.).

9. Khamidullina E. A., Chemyakin A. V. Prognoznaya otsenka riska ushcherba zdorov'yu v rezul'tate professional'noy deyatel'nosti v neftedobyche [Prediction of health damage risks caused by professional activities in the oil production industry]. Technosphere Safety. XXI Century. 2018;2(10):108–116 DOI : http://dx.doi.org/10.21285/2500-1582-2018-2-108-116 (In Russ.).

[4] Ob utverzhdenii Tipovogo polozheniya o sisteme upravleniya okhranoy truda. [On the approval of the Model Regulation on the occupational Health and Safety management System].

Submitted 19.01.2021
Scheduled in the issue 02.02.2021

Authors:

Shadrin, Robert O., Associate professor, Department of Technosphere Safety, Kalashnikov Izhevsk State Technical University (7, Studencheskaya St., Izhevsk, RF, 426069), Cand. Sci. (Eng.), Associate professor, ORCID: https://orcid.org/0000-0002-8688-6919, shadrinrobert@gmail.ru

Sevastyanov, Boris V., Head, Department of Technosphere Safety, Kalashnikov Izhevsk State Technical University (7, Studencheskaya Street, Izhevsk, RF, 426069), Dr. Sci. (Eng.), Professor, ORCID: http://orcid.org/0000-0001-7192-8891, sbv47@mail.ru

Contribution of the authors:

R. O. Shadrin — goals and objectives of the study, conduction of the research, preparation of the text, formulation of the conclusions. B. V. Sevastyanov — scientific guidance, formulation of the main concept, analysis of the results, finalization of the text, correction of the conclusions.