Modern concepts for organization of labor protection at oil and gas processing enterprises

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Abstract. Improving working conditions is a policy that primarily targets workers. This strategy is aimed at increasing the degree of protection and reducing risks at the workplace, organizing modern technologies and simultaneously safe workers. The concept, as a single defining task or order of submissions, provides an opportunity to acquire a common understanding of the process or phenomenon under study. The article considers modern concepts on labor protection organization, analyzed the state of labor protection management systems and dynamics of industrial injuries at three oil and gas processing enterprises in order to identify the most effective concepts on labor protection organization.

1. Introduction

The conceptual basis of labor protection management contains the procedure of concepts on the impact of adverse factors on employees. Choosing the right concept is a difficult step, which has terrible consequences for particularly dangerous industries, to which with the enterprises of the oil and gas industry.

Occupational Health Management is a process that involves the following steps [1]:

- Identification and identification of the problem, followed by the setting of the objective;
- Obtaining initial information on the actual state of the labor safety management system;
- Analysis to determine whether the criteria are met;
- Analysis of detected non-conformities;
- Development of measures to eliminate undesirable deviations;
- Monitoring the effectiveness of activities.

The definition of the problem identified for the solution and the setting of the goal are related to the implementation of certain foundations of labour safety management. The next steps are a variety of aspects of the analysis, which are completed by measures to correct and monitor adverse deviations. Such measures can be the development of methodological approaches to substantiating the level, structure and dynamics of income of employees, as well as their constituent elements.

The conceptual basis of the system of labour protection management should be in accordance with the current system of legislation, which is based on established social and labour relations, as well as international legal acts.
2. Calculation of performance indicators for activities

In order to determine the performance indicators of labour protection concept measures [2-4], the dynamics of industrial injuries for each oil and gas trading enterprise was analyzed (figures 1, 2, 3).

**Figure 1.** Dynamics of industrial injuries in the enterprise №1.

**Figure 2.** Dynamics of industrial injuries at enterprise №2.

**Figure 3.** Dynamics of industrial injuries at the enterprise № 3.

After analyzing the occurrence of industrial injuries for each oil and gas processing enterprise, the efficiency of carrying out measures of studied concepts on labor protection was calculated (Table 1).

The effectiveness of the measures is the proportion of the relative difference between occupational injuries in the first two years of implementation of the occupational safety concept and the relative
difference between occupational injuries in the whole considered period of time (7 years), expressed as a percentage.

A long observation period of seven years was taken in order to obtain an error-free result and eliminate random indicators.

Table 1. Results of application of labor safety concepts in enterprises.

| Labor safety concept at oil and gas processing enterprises | Efficiency of holding actions, % |
|-----------------------------------------------------------|----------------------------------|
| Enterprise No. 1                                          |                                  |
| 1. Master classes for employees of production divisions and contractors (introduced in 2014) | -23                              |
| 2. Development of internal training program "Labor safety risk management" (introduced in 2016) | -7                               |
| 3. Questionnaire of employees of the Company and contractors on safe performance of hazardous works (introduced in 2018) | 84                               |
| Enterprise №2                                             |                                  |
| 1. Work of the integrated commission to check the compliance of workplaces with the high level of production culture (weekly) (introduced in 2014) | 7                                |
| 2. Operation of the mechanism to stimulate bona fide employees by charging additional monetary remuneration (introduced in 2016)) | 64                               |
| 3 Risk assessment of identified hazards at each workplace (introduced in 2018) | 29                               |
| Enterprise №3                                             |                                  |
| 1. Annual Labor Safety Month (introduced in 2014) | -5                               |
| 2."Programmes to improve working conditions and prevent injuries" (introduced in 2016) | 5                                |
| 3. Behavioral Safety Audit (introduced in 2018) | 74                               |

According to this table, due to a well-chosen concept, the level of industrial injuries at oil and gas processing enterprises can be significantly reduced.

Having analyzed the results of the measures of the presented concepts on labor protection organization at the considered three oil and gas processing enterprises, it is possible to distinguish the most effective of them. A comparative analysis of the selected concepts showed that the following several concepts can lead to the most effective results (the efficiency of carrying out activities is more than 50%):

1) Questionnaire of Company employees and contractors on safe performance of hazardous works (84%).
2) Operation of the mechanism to stimulate bona fide employees by charging additional monetary remuneration (64%).
3) Behavioral safety audit (74%).

3. Regression analysis of occupational injuries
Regression in mathematical statistics and probability theory is the dependence of the mean value of any given value on another value or several values.

Regression analysis is a quantitative method of identifying the kind of mathematical function in the causal relationship between variables.

The fundamental purpose of regression analysis is to establish an analytical form of communication in which the change of the result is due to the influence of one or more factor characteristics, and the aggregate of all other factors, which also affect the effective characteristic, is taken as constant and average values.
The main tasks of regression analysis are [5,6]:

A) Establishing a valid form of dependence. With regard to the nature and form of the relationship between the phenomena, groups of regressions are distinguished: positive linear and non-linear, as well as negative linear and non-linear regression.

B) Establishing the function of the sought regression in the form of a mathematical equation of any type and determining the influence of the explained variables used on the dependent variable.

C) Analyze unknown derived dependent variable values.

Using the derived regression function, you can define dependent variable values within the range of specified values of the explanatory variables used (that is, Find a solution to the interpolation problem) or evaluate the progress of the process outside the initial interval (i.e. Find a solution to the extrapolation problem). The result is an estimate of the resulting dependent variable value.

In the field of labor protection, 4 groups of occupational injury factors are determined [7-9]:

1. Organizational (poor quality or lack of training in safety principles; lack of appropriate control; Violation of existing generally accepted requirements, rules, norms, standards, instructions; Failure to implement recommended safety measures; Violation of mandatory rules of equipment operation; Incorrect operation of equipment, mechanisms and tools).

2. Technical (failure of used production equipment, working mechanisms and tools; Failure or absence of protective fences, alarm and interlocking devices, safety devices).

3. Sanitary and hygienic (increased (above MPC level) concentration of harmful substances in the air of the working zone; Insufficient or non-ergonomic lighting; Increased levels of industrial noise and vibration; Non-compliant microclimatic conditions; Presence of harmful radiation (higher than MPC level); Violation of prescribed personal hygiene rules).

4. Psychophysiological (performance of erroneous actions due to fatigue of the worker, excessive severity, tension and monotony of the produced work; The condition of the employee affected by the illness; actions by negligence; Mismatch of the level of psychophysiological data of the employee of the applied equipment or the work done).

Considering which of the factors revealed the level of industrial injuries in oil and gas processing enterprises with the most effective measures, regression equations were drawn up, which show the dependence of the level of industrial injuries on the factors, where y is the index of industrial injuries for each factor, x is the factor that affected injuries.

Regression equations taking into account the group of factors of industrial injuries have the form:

1. By organizational factors, the equation:

\[ y = -1,98901 + 98,9011x_1 \]  \( (1) \)

2. By technical factors equation:

\[ y = 6,164557 - 132,911x_2 \]  \( (2) \)

3. By sanitary and hygienic factors equation:

\[ y = 5,016129 - 177,419x_3 \]  \( (3) \)

4. By psychophysiological factors equation:

\[ y = 4,8 - 200x_4 \]  \( (4) \)

4. Conclusion

The work identified key factors of effective implementation of the concept of labor protection management at oil and gas trading enterprises: behavioural audit, stimulation and questionnaire of employees. These factors have been linked to the implementation of certain principles of labour safety management. The level of industrial injuries determined by regression equations will allow to identify the effectiveness of labour protection measures at oil and gas industry enterprises and to make the right
choice when deciding on the choice of the concept on which the labor protection management system of this enterprise will be based.

References
[1] Fedosov A B, Wadulina N B, Shabanov B, Abdarkhananova K H 2017 Peculiarities of organization of industrial safety and labor protection at oil and gas industry enterprises Problems of collection, preparation and transport of oil and petroleum products 4(110)
[2] Abdarkhanov N Kh, Vadulina N V., Fedosov A V, Ryamova S M, Gaiein E Sh 2017 A new approach for a special assessment of the working conditions at the production factors impact through forecasting the occupational risks Man in India 23(11) 156-9
[3] Nikulin A, Nikulina A Y 2017 Assessment of occupational health and safety effectiveness at a mining company Ecology, Environment and Conservation 23(1) 351-5
[4] Fedosov A V, Khamitova A N, Abdalkhananova K N, Abdalkhanov N Kh 2018 Assessment of the human factor influence on the accident initiation in the oil and gas industry Территория нефтегаз 1(2) 62-70
[5] Fedosov A V, Abdalkhanov N Kh, Gaiein E Sh, Sharafutdinova G M, Abdalkhanova K N, Shammatova A A 2018 The use of mathematical models in the assessment of the measurements’ uncertainty for the purpose of the industrial safety condition analysis of the dangerous production objects International Journal of Pure and Applied Mathematics 10(119) 433-7
[6] Garipov R F, Sharafutdinova G M, Barakhmina B 2019 Risk analysis based on the results of safety culture assessment Labor safety in industry 9 (2) 82-8
[7] Sharafutdinova G M, Gilyazov A, Kazakov C R, Salimov R O, Nikolayeva A D 2016 Production safety management system at enterprises Oil and Gas Business 3 (10) 337-49
[8] Sharafutdinova G M, Gilyazov A, Kazakov C R, Salimov R O, Nikolayeva A D 2016 Improvement of the industrial safety and labor protection management system at the enterprises Industrial safety expertise and diagnosis of hazardous production facilities 2 (8) 9-11
[9] Sharafutdinova G M, Amirov D A, Yousupova L R, Sharipov F 2016 Peculiarities of labor protection and industrial safety at industrial enterprises Journal of young scientist UGNTU 4 (8) 182-7