Categorization and gradation of hazardous actions of industrial workers: methodological aspects

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Abstract. The paper defines concepts of “dangerous working conditions” and “dangerous actions of workers”. Regulatory and various doctrinal approaches to differentiating the actions of workers violating labor protection requirements are considered, their specific features, advantages and disadvantages for use in industrial enterprises are analyzed. The author proposes a method of categorizing and grading dangerous actions of workers of industrial enterprises. The method is developed with regard to the specifics of the functioning of oil stores. The work is based on the method of expert assessments, applied in the form of an individual expert survey. The survey was conducted among the experienced specialists of electrical and electrotechnological fields, whose professions and positions are typical of a modern warehouse of petroleum products. The survey results allowed compiling the most objective and complete list of all possible behavioral deviations of a particular professional category of workers. The resulting list is the basis of the reference guide of the developed automated system for personified accounting of the dangerous actions of workers engaged in the operation, maintenance and repair of electrical equipment in oil product warehouses.

1. Introduction and background

In the research of specialists of the DuPont company V.Kh. Heinrich, F. Bird and others, the ratio of dangerous working conditions and dangerous actions of workers is graphically represented as so-called “Pyramid of accidents” [1]. Statistical data imply the unconditional prevalence of the “human factor” (ignoring labor protection requirements, non-observance of them due to ignorance, fatigue, lack of knowledge and experience, etc.). As a rule, they are from 85 to 95 incidents out of 100. The data of foreign researchers are similar to Russian ones: up to 80 percent or more of the causes of accidents at the facilities supervised by Rostekhnadzor (the Federal Service for Ecological, Technological and Nuclear Supervision) are people’s actions [2]. The search for means and methods of preventing the dangerous production behavior of workers is still relevant today. The modern managerial paradigm is based on the following thesis: the basis of all organizational and technical measures to ensure occupational safety in an organization is a comprehensive, detailed analysis of the potential risk and danger of industrial accidents both in quantitative terms (in terms of frequency and severity data), and in qualitative terms (with a classification by the nature of the causes of industrial accidents that are real for a given organization) [3].

2. Materials and methods

There are several main lines of research.
Firstly, it is the differentiation, categorization and gradation of dangerous working conditions. The use of risk management methodology allows differentiation of dangerous working conditions in the context of real or potential risk, which allows, first of all, optimal planning of measures to minimize them, including their budget [4]. In 2017, Rostrud (Federal Labor and Employment Service) presented a list of typical violations of labor law, incl. mandatory labor protection requirements with their classification (differentiation) according to the degree of risk of harm and the severity of the consequences of such violations for the worker [5]. Classification of typical violations allows making more transparent decisions regarding the use of sanctions for violation of mandatory requirements [6]. There are three categories of risk (high, medium and low), depending on the negative consequences for the worker. The disadvantages of this List of typical violations include the lack of consideration for the specifics of the worker’s activities.

Secondly, attempts are being made to differentiate the dangerous actions of workers. As a rule, searches are also conducted using risk management methodologies, i.e. the severity of the behavioral act is determined depending on the actual or potential damage with assigning points to them [7].

It is necessary to point out the lack of unanimity of opinion regarding the “weight” of this or that dangerous action of worker in the common array of behavioral deviations and it is possible to point out three main reasons.

The first is that in the Russian legislation there is no normative definition of the notion “dangerous action of worker”. As a result, there is no unanimity in understanding its nature, content and key characteristics.

The second is the absence of clear and unambiguous categorization criteria (distribution of dangerous actions of workers by categories) and gradation criteria (their distribution by hierarchy within a category).

The third is the absence of a complex differentiation of both the types of dangerous behavior of workers and its consequences in Russian labor legislation.

In the foreign labor law of the USA and the Netherlands, differentiation and gradation of violations of labor protection requirements by employees and employers has been carried out [8]. The lack of unanimity of understanding and criteria for the distribution of dangerous actions of workers by categories, among other things, violates the constitutional principles of equal rights of citizens and labor rights of workers, since at the level of local legislation their misbehavior, unevenly valued, entail different in severity legal consequences [9-12].

3. Experimental section

To solve this problem, an attempt has been made to develop a methodology for categorizing and gradation of dangerous actions of workers on the material of personnel operating, maintaining and repairing electrical equipment in oil stores.

The methodology is based on a method known in the theory of knowledge as a method for expert evaluation in the form of an individual expert survey (the entire survey covered 10 specialists with at least 5 years of work experience, the necessary knowledge and practical experience in labor protection at the fuel and energy facilities), which made it possible to compile the most objective and complete list of all possible behavioral deviations of a specific professional category of workers. Specific positions and professions of electrical and electrotechnological personnel, typical for a modern oil store, were determined on the basis of the provisions of the professional standards and the UWRB nomenclature taking into account the specifics of workers' activities [13-18]. The results are presented in Table 1.

Regulations containing labor protection requirements for the operation, maintenance and repair of electrical equipment in oil stores are presented in Table 2.
Table 1. Positions of electrical and electrotechnological personnel in oil stores.

| Personnel category | Approximate nomenclature of positions and professions | Electrical Safety Group |
|--------------------|------------------------------------------------------|-------------------------|
|                    | Electrotechnical personnel                          | 5                       |
|                    | Power engineer                                      |                         |
|                    | Electric fitter of repair of oil tank farm’s equipment. | 4                       |
|                    | Electrotechnological personnel                      |                         |
|                    | Pumper                                              | 3                       |
|                    | Boiler operator                                      | 2                       |
|                    | Electric fitter of manual welding                   | 2                       |
|                    | Fitter of engineering unit                          | 2                       |

Table 2. Regulations containing labor protection requirements for the operation, maintenance and repair of electrical equipment in oil stores.

| No. | Regulatory document establishing requirements, nature of requirements |
|-----|---------------------------------------------------------------------|
| 1   | Rules of technical operation of electrical installations of consumers. Approved by order of the Ministry of Energy of the Russian Federation dated January 13, 2003 No. 6 |
| 2   | Rules of technical operation of oil tank farms. Approved by order of the Ministry of Energy of the Russian Federation dated June 19, 2003 No. 232 |
| 4   | Rules on labor protection in the operation of electrical installations. Approved by order of the Ministry of Labor of Russian Federation dated July 24, 2013 No. 328n |
| 5   | Rules on labor protection during storage, transportation and sale of oil products. Approved by order of the Ministry of Labor of Russian Federation dated November 16, 2015 No. 873n |

The questionnaire includes 113 positions, each of which reflects a particular type of violation of the requirements of regulatory and technical acts, presented in Table 2. The form of the questionnaire and some examples of dangerous actions of workers to be assessed are presented in Table 3. Experts, on the basis of personal experience, carried out the categorization of dangerous actions of personnel presented in the questionnaire, dividing them into two categories: “C” and “S”.

Table 3. Questionnaire “Categorization and assessment of the severity of dangerous actions of electrical and electrotechnical personnel in oil stores (extract).”

| No. of dangerous action | Category of possible consequences (C) and severity in points (S) for workers of various professions |
|------------------------|--------------------------------------------------------------------------------------------------|
|                        | Energy worker | Electric fitter of repair of oil tank farm’s equipment | Pumper | Boiler operator | Electric fitter of manual welding | Fitter of repair of engineering units |
|                        | C S C S       | C S C S                                               | C S C S | C S C S       | C S C S | C S C S |
| 1                      | 1 7 0 0      | 0 0 0 0                                               | 0 0 0 0 | 0 0 0 0      | 0 0 0 0 | 0 0 0 0 |
| 19                     | 1 10 1 10    | 1 10 1 10                                            | 1 10 1 10 | 1 10 1 10 | 1 10 1 10 | 1 10 1 10 |
| 25                     | 1 10 1 10    | 1 10 1 10                                            | 1 10 1 10 | 1 10 1 10 | 1 10 1 10 | 1 10 1 10 |
| 31                     | 1 8 1 8      | 1 8 1 8                                              | 1 8 1 8 | 1 8 1 8      | 1 8 1 8 | 1 8 1 8 |
| 61                     | 0 0 2 4      | 0 0 0 0                                              | 0 0 0 0 | 0 0 0 0      | 0 0 0 0 | 0 0 0 0 |
| 94                     | 0 0 0 0      | 0 0 0 0                                              | 0 0 0 0 | 0 0 0 0      | 0 0 0 0 | 0 0 0 0 |
| 102                    | 0 0 0 0      | 0 0 0 0                                              | 0 0 0 0 | 0 0 0 0      | 0 0 0 0 | 0 0 0 0 |
1 The worker has not organized the development and maintaining of the necessary documentation on the organization of operation of electrical installations;
19 When working in particularly adverse conditions (switch wells, switchgear compartments, boiler drums, metal tanks), a worker uses portable lamps with a voltage higher than 12 V;
25 The worker used open fire sources in the territory of the tank farms;
31 The worker smoked in the territory and in the premises of oil stores;
61 The worker using power tools and hand-held electric machines works from accommodation ladder;
94 The worker performed electric welding in explosive and fire hazardous premises and objects without safety work permit;
102 The worker performs welding of equipment and communication lines under voltage, filled with flammable or toxic substances, as well as under the pressure of non-flammable liquids, vapors and gases.

C dangerous actions, due to which, according to the expert, the possibility of causing harm to health or death of two or more persons is not excluded;
S dangerous actions, due to which, according to the expert, the possibility of causing harm to the health of one person or his death is not excluded.

4. Results and discussion
The number and basic characteristics of the selected categories are based on the principle applied in the national criminal legislation. After processing the results of this survey, each dangerous action is assigned with a category and severity, defined as the arithmetic mean value of expert assessments, rounded to the whole in accordance with mathematical rules [19].

5. Conclusion
The obtained results were used as the basis for the reference book of the developed automated system for personalized recording of the dangerous actions of workers involved in the operation, maintenance and repair of electrical equipment in oil stores [20].

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