Determination of Periodicity of Certification Electrical Personal

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Abstract. The article presents the data on electrical injuries to staff caused by violation of labour protection rules. Proposed and justified system of certification of electrotechnical personnel, taking into account the education (higher, secondary professional, primary professional group for electrical, the result of the previous test knowledge of electrical safety, floors appraise. The results of the knowledge test using the developed system.

1. Introduction

In today's manufacturing worker safety is largely determined by the level of qualification and depends on the quality and content of training [1–3]. Training of labour safety is conducted for all production activities worker: during practical training directly in the work process, the retraining and advanced training. For electrical personnel training system is regulated by the Rules of technical operation of electrical installations [4]. Despite the considerable attention paid to the security issues identified in the analysis of the causes of electrical injuries and the prevalence of organizational factors (70%), including violation of instructions and regulations on safety (20%), casts doubt on the effectiveness of the existing training system. In addition to 50% of electrical shocks with organizational causes, occur before the expiration of two months from the date of the last instruction that also indicates a low efficiency of the latter [5].

2. Theoretical Part

The proposed grading system includes the following provisions.
1) Verification of knowledge of rules, job descriptions and operational instructions performed by testing personnel test level II [6]. The tests are based on group on electrical safety and work in progress [7].
2) Results of the test are handled as follows. The test consists of tasks at a given level and standard, that is, the sample of complete and correct execution of actions. The standard is easily determined number (R) essential operations, leading to the solution of the tasks of the test of assimilation. Comparing the student answer with a benchmark for number of students correctly performed the operations (a) test of all required (R) gives the possibility of determining the coefficient of absorption k_α [6]:

$$k_\alpha = \frac{a}{p} \tag{1}$$

The absorption coefficient can be normalized ($0 < k_\alpha < 1$). If $k_a > 0.7$, the learning process can be considered completed, $k_a < 0.7$ – the worker in follow-up commits systematic errors. Usually the response is estimated [6]:

Table 1. Evaluation of test results

k_α	Rating
Less than 0.7	2
0.7 – 0.8	3
0.8 – 0.9	4
0.9 – 1.0	5

3) All employees are divided into the following four groups depending on individual characteristics (gender, group on electric safety, education) [8]:
1. Electrical staff male 5 group on electrical safety ($\tau=0,0129$).
2. Operational staff female with 3, 4, 5 group on electrical safety ($\tau=0,0129$).
3. Operational staff male with 3, 4 group on electrical safety ($\tau=0,018$).
4. Repair male staff 3, 4 group on electrical safety ($\tau=0,023$).

4) If you take $I_\infty=0$, where I_∞ – is determined by the level of knowledge after quite a long period of time, the law changes the information in memory can be written [9]:

$$I(t) = I(0) \cdot e^{-\tau \cdot t}, \qquad (2)$$

where $I(0)$ is the level of knowledge shown in the exam; τ given for each group; t – months after certification.

Calculated date the following certification for the formula (2). Initial level $I(0)$ is equal to the absorption coefficient, τ we counted for each group. To determine the date, the following certification is required to the current date to be added is found by the formula (2) the t value.

5) Testing and calculation date the following certification is most convenient to produce using computer technology.

The program "Certification" is developed to calculate the recommended date for the next assessment of the results of the current and individual characteristics of workers and the accumulation of data on results of certification.

Program was created in Microsoft Access 2002.

The program has the following features:
– filling of a database of results of certification;
– withdrawal recommended date of certification;
– accumulation of data on results of certification.

The program is as follows:
1. Input.
   1.1. In the database window, click Forms in the Objects list.
   1.2. Select the form "certification Results".
   1.3. Click the Open button on the database toolbar.
   1.4. Enter the following data (Figure 1): surname, name, patronymic, floor, electrical, education, date of appraisal, the appraisal results (% correct answers).
2. Print reports on the recommended date of the subsequent certification.
   2.1. In the database window choose Reports in the Objects list.
   2.2. Select the report (the program contains five reports: the first group, second group, third group, fourth group, to retake).
   2.3. Click the Open button on the database toolbar (Figure 2).
   2.4. On the File menu, click print.
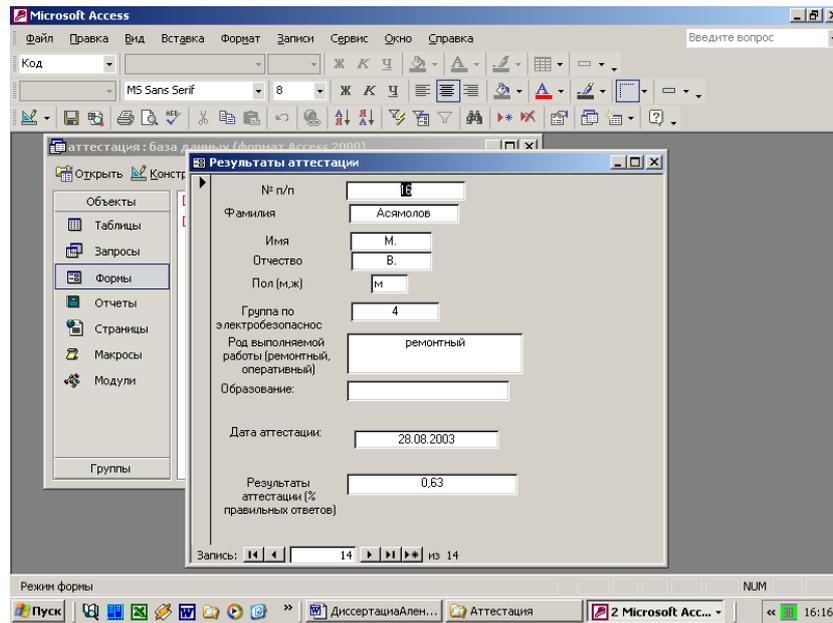   2.5. Specify the desired settings in the Print dialog box.

Figure 1. The data entry form

To determine the efficiency of the used method was carried out testing involving electrical personnel main electric networks.

In testing was attended by 26 people, including 4 maintenance personnel 5 group with electrical, 22 administrative and technical staff 3, 4, 5 groups with electrical. Data on the results of testing (last name, first name, patronymic, group electrical safety, the kind of work performed, education, date of test, % correct answers) was registered in the program of "Certification", which automatically divided the workers into groups with similar individual characteristics the speed of forgetting information [8] and considered the recommended date of the subsequent certification.
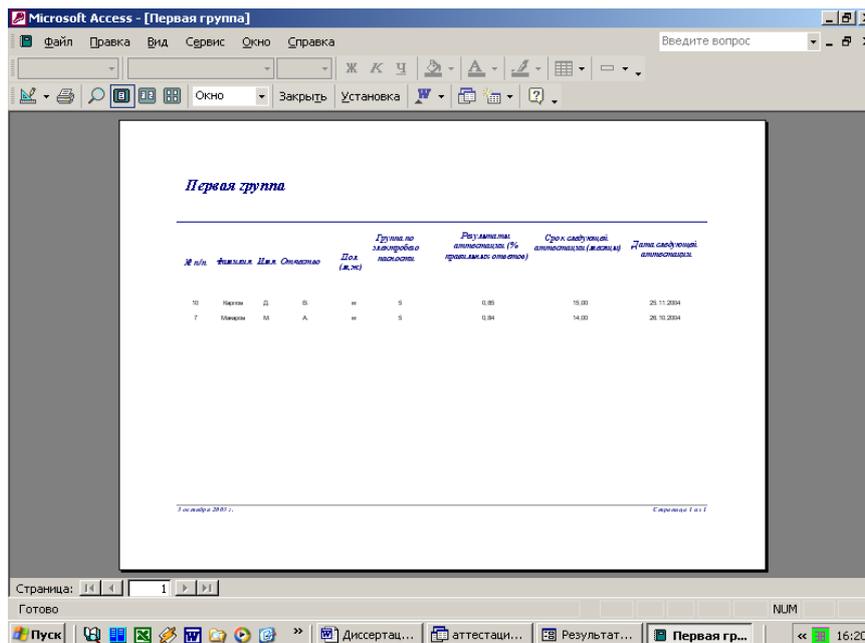

Figure 2. Report example "First group"

The results are shown in Figure 3–5 [10].

For male workers with 5 group on electric safety (13) the recommended period following certification varies from 4 to 22 months (see Figure 3). Seven people recommended date of next certification 15–22 months, which exceeds the regulatory documents of the period (1 year). This can be explained by different training on labour protection of the personnel.

For administrative and technical staff 3, 4 group on electrical safety recommended date of next certification between 3 to 13 months (see Figure 4). Only one worker, the period following certification exceeds the norm (13 months).

Extraordinary certification requires five administrative and technical staff (see Figure 5).

First group

№ n/n	Surname	Name	Middle name	Gender (m,f)	Group of the electric safety	Results of the certification (% right answers)	Date of the next certification (months)	Date of the next certification
15				м	5	0,74	4,00	22.01.2004
24				м	5	0,74	4,00	22.01.2004
25				м	5	0,78	8,00	23.05.2004
26				м	5	0,78	8,00	23.05.2004
38				м	5	0,78	8,00	23.05.2004
16				м	5	0,81	11,00	23.08.2004
23				м	5	0,85	15,00	21.12.2004
27				м	5	0,85	15,00	21.12.2004
28				м	5	0,85	15,00	21.12.2004
29				м	5	0,85	15,00	21.12.2004
31				м	5	0,89	18,00	23.03.2005
32				м	5	0,89	18,00	23.03.2005
21				м	5	0,93	22,00	23.07.2005
20				м	5	0,96	24,00	22.09.2005

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Figure 3. The report "the First group" (Control)

Third group

№ n/n	Surname	Name	Middle name	Gender (m,f)	Group of the electric safety	Results of the certification (% right answers)	Date of the next certification (months)	Date of the next certification
40				м	4	0,78	6,00	23.03.2004
39				м	4	0,74	3,00	22.12.2003
37				м	4	0,78	6,00	23.03.2004
36				м	3	0,81	8,00	23.05.2004
35				м	4	0,74	3,00	22.12.2003
19				м	3	0,89	13,00	23.10.2004
18				м	4	0,81	8,00	23.05.2004

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Figure 4. The report's "Third group" (Control)

To retake

№ n/n	Surname	Name	Middle name	Gender	The kind of the performed work	Group of the electrical safety	Results of the certification (% of the right answers)
34				м	administrative and technical	4	0,56
33				м	administrative and technical	4	0,59
30				м	administrative and technical	5	0,7
22				м	administrative and technical	4	0,63
17				м	administrative and technical	4	0,67

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Figure 5. The report "to retake" (Control)

Implementation in practice of the proposed system of certification will reduce the likelihood of electrooptic situations caused by violations of norms and rules of labour protection, from 2.4 to 17 times, while increasing the reliability of power supply by eliminating emergency situations.

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