

DOI: 10.25696/ELSYS.VC2.EN.2

ASSESSMENT CRITERIA OF PROFESSIONAL STAFF ADAPTATION PARTICIPATING IN PROCESSING OPERATIONS ON HANDLING WITH NUCLEAR FUEL AND RADIOACTIVE WASTE ACCORDING TO CHARACTERISTICS OF MULTIPLE INTELLIGENCES

E. S. Shchelkanova¹, V. V. Rataeva², A. F. Bobrov², V. Y. Shcheblanov²

¹ Center for Radioactive Waste Management — Branch of GB. Andreeva SZTs “SevRAO” — branch of FSUE “RosRAO”, Zaozersk, Murmansk region

² State Research Center — Burnasyan Federal Medical Biophysical Center of Federal Medical and Biological Agency (SRC — FMBC) of Russia, Moscow, Russia.

Abstract: *Formalized, decision rules and assessment criteria of professional adaptation level of staff participating in processing operations on handling with nuclear fuel and radioactive waste have been developed according to the comparison results of professional adaptation assessment by the multiple intelligences characteristics. Direction to the most dangerous and responsible work of staff with high level of professional adaptation allows to increase safety of work performance and objective assessment of professional qualities of staff conduces to improve methods and means of enhancement by using deliberate training and staff recruitment.*

Keywords: *Vibrainage technology, multiple intelligences, scientific assessment, professional qualifications, professional success, professional adaptation, handling with nuclear fuel and radioactive waste, temporary radioactive waste storage facilities.*

One of the main activities of the Center for RW Management — Andreeva Bay SZTS SevRAO branch of the FSUE “RosRAO” branch is the management of spent nuclear fuel (SNF). Work with SNF consists in removing fuel assemblies of nuclear reactors decommissioned from nuclear submarines, reloading them into transport containers with subsequent removal for reprocessing. The danger of the work performed relates to the fact that during removing fuel assemblies, abnormal situations may occur that lead to radioactive contamination of industrial premises and the territory of a temporary storage facility. The conditions of professional staff activity described in [1]. The safety of work on the management of SNF and radioactive waste (RAW) largely depends on the professional characteristics of the worker, the leading ones being professional preparedness and professional success. In accordance with the works [2, 3], the professional qualification (PQ) of an employee is understood as the correspondence of the level of knowledge and skills acquired in the process of special training and necessary for performing labor functions in a particular job to the requirements of professional standards (job description, qualification reference book). Professional success (PS) of an employee — proper and effective implementation of all work and the solution of all tasks that determine the content of activities in a given position and (or) at a given workplace. In general, professional characteristics (PQ&PS) should be assessed using valid methods and techniques used in the educational units of Rosatom State Corporation, direct and indirect characteristics of the success of the prescribed professional duties of the employee.

Practice shows that vocational training in its modern sense is carried out only in training centers at nuclear power plants. On them, operating personnel undergoes routine training / retraining on full-scale simulators, their knowledge level is assessed. With regard to the success of professional activity, the heads of departments try not to advertise the mistakes of their employees if they do not lead to significant disruption of the work of technological processes. Therefore, when assessing the professional characteristics of PS and PS, which together characterize the level of professional adaptation (PA) of an employee, peer review is the most accessible tool. Since the conduct of an expert assessment is associated with the expert's subjectivity, it is of scientific interest to assess and predict the professional adaptation of an employee according to objective methods. In particular, using the methodology for assessing multiple intelligence [4], which has proved its effectiveness in predicting student performance [5].

The aim of this study was to develop the criteria for the professional adaptation of persons involved in the management of spent nuclear fuel and radioactive waste, according to the characteristics of multiple intelligences.

Materials and Methods

The object of the research was the personnel of the main (complex for storage and handling of waste (CSHW)) and ancillary production (radiation safety service (RSS)) PVC GB. Andreeva SZTS "SevRAO". In total, 16 of the main production were tested, and 28 of the auxiliary production. Testing was carried out using the VibraMI program in the framework of the Russian-Norwegian cooperation on the rehabilitation of radiation-hazardous facilities in the North-West of Russia (contract No. M18-15 / 02 dated 02/23/2015) and the agreement of the FSBI SRC FMBTS them. A. I. Burnazyana with SZTS "SevRAO". The expert assessment of professional adaptation was carried out using a questionnaire developed by specialists of the FSBI SRC FMBC A. I. Burnazyan. The results of the study were analyzed using the program STATISTICA v. 8.0.

Results

The questionnaire for expert assessment of professional adaptation included questions assessing: 1) the level of theoretical knowledge and competence; 2) the speed of mastering professional skills; 3) errors in the work; 4) level of adherence to the principles of safety culture and manufacturing instructions; 5) the desire to improve professional skills; 6) mental professional performance; 7) physical professional performance; 8) behavior in a difficult production environment; 9) prevailing mood background; 10) forms of manifestation of emotions in behavior in industrial situations; 11) temperament; 12) features of intelligence; 13) own self-assessment of the evaluated employee; 14) the level of communication (professional sociability); 15) the level of self-control behavior in a production environment; 16) the level of acceptance of industrial ethics, the ability to obey the senior position; 17) the ability to organize their

work; 18) interoperability in group production activities; 19) state of health; 20) the ability to fully rely on the employee in emergency situations. The directors of the testees acted as experts.

The method of automatic classification identified 3 groups of workers: individuals with high (BY), medium (CY) and low (HY) professional adaptation. Figure 1 shows the averaged “profiles” of the selected groups on the questionnaire. The average recognition accuracy of groups according to the results of discriminant analysis was 98.9%.

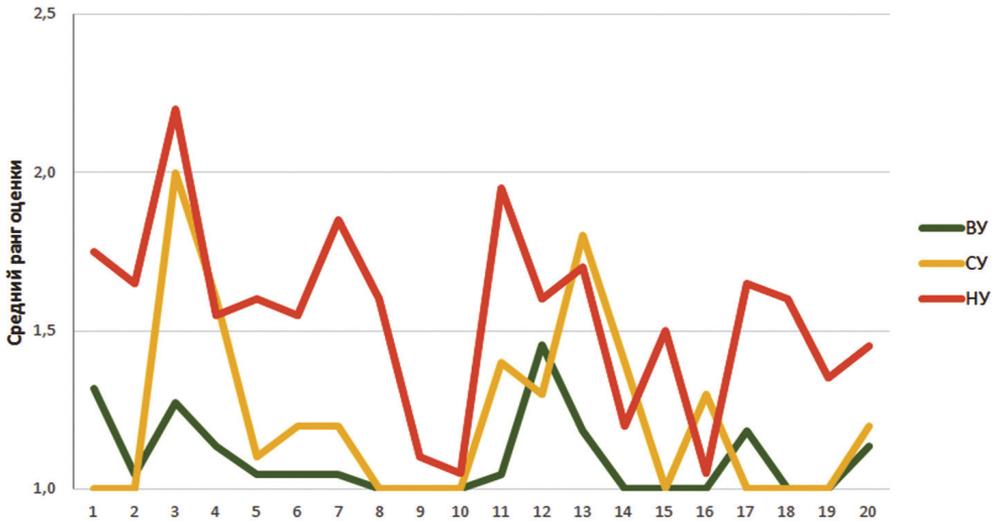


Fig. 1. Averaged profiles of workers with different levels of professional adaptation. The number of questions of the questionnaire plotted on the abscissa

As follows from the above data, workers with a low level differ from workers with a high level of professional adaptation, a lower level of theoretical knowledge and competence, a lower rate of mastering professional skills, a greater number of errors in work, a lower level of adherence to the principles of safety culture and production instructions. Also less desire to improve professional skills, lower mental and physical performance, evasion of participation in the development decisions in a complex production environment, low ability to organize their work and the ability to interact with group production activities. Table 1 presents the profiles of the multiple intelligence of workers with high and low levels of professional adaptation.

As follows from the above data, the workers of the main production with a high level of PA reliably expressed the motor-motor type of intelligence, as well as the musical-rhythmic (pronounced tendency). This suggests that staff with a high level of PA is characterized by well-developed both large motor skills and fine motor skills, allowing them to perform various actions with high-tech equipment. Well-developed coordination of movements, balance, agility, strength, flexibility are necessary for the production of works on the storage and management of spent nuclear fuel and

radioactive waste. Also, personnel with a high level of PA are characterized by increased sensitivity to sounds and phonemes, which is to a large extent the presence of certain inclinations and abilities.

Table 1

Profiles of multiple intelligence of workers with high and low levels of professional adaptation and reliability (p) of their differences

MI scale	SCHW			RSS		
	PA level			PA level		
	high	low	p	high	low	p
1 IA	43,8	45,9	0,93	49,8	66,1	0,282
2 PH	55,0	29,2	0,09	49,2	47,6	0,905
3 LM	42,6	30,8	0,42	40,0	65,9	0,077
4 BM	22,4	28,0	0,81	25,8	7,7	0,120
5 VS	43,6	56,1	0,45	67,1	48,0	0,08
6 NL	43,7	75,7	0,05	81,4	83,3	0,772
7 BK	77,8	43,0	0,01	76,1	58,1	0,05
8 MR	66,2	36,1	0,08	38,2	53,7	0,209
9 AS	76,2	74,9	0,93	80,6	76,4	0,753
10 VL	57,5	44,4	0,55	44,2	36,9	0,654
11 CR	35,5	38,8	0,84	30,3	42,7	0,336
12 IE	76,4	77,7	0,94	73,3	52,2	0,07

Workers with a high level of PA auxiliary production (RSS) characterizes the predominance of motor, interpersonal and visual-spatial types of intelligence. For such workers, along with well-developed motor skills, such qualities as the ability to establish social contacts, work in a team, the ability to clearly define their position, taking into account the collective opinion already formed, the ability to perceive surrounding objects and phenomena in three-dimensional space, regardless of their initial position and dynamics. RSS personnel tend to work with constantly changing chemical and chemical shifts, monitor the current radiation situation, monitor compliance with the requirements of radiation safety rules, prevent personnel from overexposure, work with various radiation monitoring devices, which leads to the above qualities.

Using canonical discriminant analysis [6], formalized decisive rules were developed for assessing the level of professional adaptation of persons participating in SNF and RAW management operations (fig. 2).

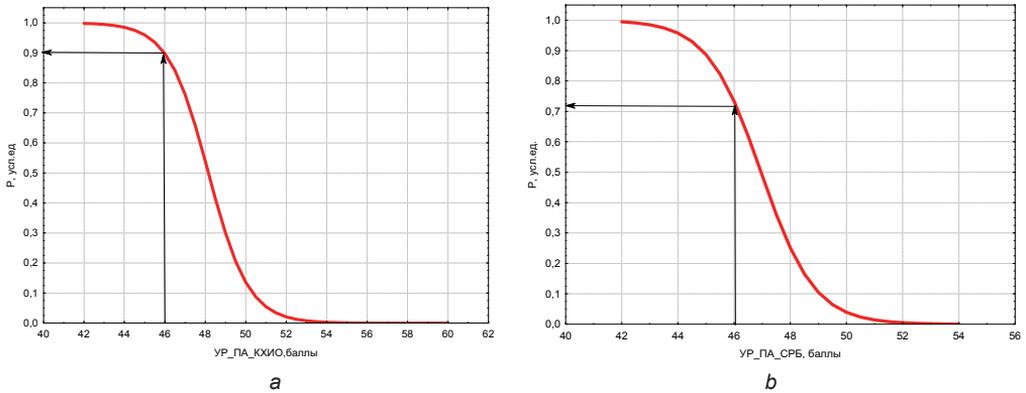


Fig. 2. Probability nomograms identification of low-level professional adaptation for the CSHW (a) and RSS (b) workers

The abscissa axis shows the values of the integral indicators for assessing the level of professional adaptation for workers of the main and auxiliary production:

$$UR_PA_CSHW = 99.72 - 1.052 \times PR + 0.206 \times MR - 0.459 \times VI - 0.483 \times BA + 0.31 \times VP + 0.404 \times MD, \text{ points}$$

$$UR_PA_RSS = 56.1 + 0.09 \times BK + 0.6 \times MD + 0.41 \times VP - 0.28 \times PR - 0.31 \times LM - 0.19 \times MP - 0.25 \times VI - 0.33 \times BA, \text{ points}$$

On the ordinate axis — the probability of attributing an employee to persons with a low level of professional adaptation.

For example, if $UR_PA_CSHW = 46$ points, the probability (see fig. 2a) that an employee has a low level of professional adaptation is 0.9 (90%), with $UR_PA_SRB = 46$ points — 0.72 (72%) (see fig. 2b).

Conclusions

1. VibraMI program is an effective tool for assessing and predicting the professional adaptation of persons participating in operations with SNF and RAW.
2. Developed formalized decision rules and criteria allow, according to the assessment of multiple intelligences, to assess the level of professional adaptation of an employee in order to choose ways and means to improve it through the training of professionally significant qualities of an employee.
3. Sending to especially dangerous and responsible work of persons with a high level of professional adaptation will increase the safety of work on the management of spent nuclear fuel and radioactive waste.

References:

1. Rataeva V. V. (2018). Criteria for the professional selection of persons to perform work on the management of spent nuclear fuel and radioactive waste according to the assessment of

- multiple intelligence // Modern Psychophysiology. The Vibraimage Technology: Proceedings of the 1st International Conference, June 28–29, 2018, Saint Petersburg, Russia. St. Petersburg: ELSYS Corp. P. 33–39.
2. *Scheblanov V. Y., Sneve M. K., Bobrov A. F.* (2012). Monitoring human factor risk characteristics at nuclear legacy sites in northwest Russia in support of radiation safety regulation // *Journal of Radiological Protection*. No. 4. P. 465–477.
 3. *Bobrov A. F., Kosenkov A. A., Sedin V. I., Scheblanov V. Yu.* (2017). Assessment of the functional reliability of workers in hazardous industries // *Collection of reports of the Second International Conference “Human Factor in the Energy Industry XXI: Quality, Reliability, Health”*. April 6–7, 2017, Moscow. M. P. 136–144. (In Russian)
 4. *Minkin V. A., Nikolaenko Y. N.* (2017). Vibraimage and multiple intelligence. St. Petersburg: Renome. DOI: 10.25696/ELSYS.B.EN.VIMI.2017.
 5. *Akimov V. A., Martynov O. E., Minkin V. A., Nikolaenko Y. N., Sacerdov P. I., Kolpakov A. S., Kupriyanov M. S.* (2018). Predicting student performance from the results of testing multiple intelligence with vibraimage technologies and VibraMI programs // *Modern Psychophysiology. The Vibraimage Technology: Proceedings of the 1st International Conference, June 28–29, 2018, Saint Petersburg, Russia*. St. Petersburg: ELSYS Corp. P. 62–70. (In Russian)
 6. *Kim J., Mueller Ch. U., Cleck W. R. et al.* (1989). Factor, discriminant and cluster analysis: *Trans. from English / Ed. by I. S. Enyukova*. Moscow: Finance and Statistics. 215 p. (In Russian)