# Vibraimage Technology in Tasks of Assessing Security Culture in Dangerous Production

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***Abstract:*** *The article is devoted to the issues of culture assessment in the management of spent nuclear fuel and radioactive waste. The IAEA recommended safety culture assessment procedures using various missions and safety culture indicators are described. The necessity of "internal" (by the enterprise) assessment of the state of safety culture is substantiated. The methodology and criteria for culture assessment in dangerous production using vibraimage technology are developed.*

***Keywords:*** *Hazardous industries, safety culture, safety culture indicators, vibraimage technology, unconscious response, conscious response, safety culture lattice, growth points.*

Humanity in its development has always been faced with threats. The first were predominantly epidemiological diseases that claimed millions of lives in medieval cities. The development of hygienic science made it possible to identify the causes of diseases and to develop recommendations for human behavior in everyday life to minimize them. However, you can perfectly know the rules, but, for various reasons, do not follow them. While elementary hygiene rules through education for many generations ("Have you washed your hands before eating?") Have not moved to the subconscious level, the threat of pandemics continued.

The industrialization of society has added new threats. At first, they concerned only damage to the health of the employee. A new science has appeared: labor protection (LB), which has developed the rules for safe human behavior at work. However, constant briefings on the subject of safety measures for employees of enterprises under their personal signature do not reduce mortality at work to zero. One of the main reasons: failure to comply with the rules of LB due to the personal characteristics of the employee, the lack of their consolidation at the subconscious level.

The inclusion in the industrial sector of industrialized countries of enterprises with potentially hazardous technologies (nuclear, chemical, oil, microbiological and other industries) has increased the threat to workers, enterprises and the environment. The concept of "industrial safety" appeared, which is defined in the State Standard for Safety

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in Extraordinary Conditions as the state of protection of the population, production personnel, national economy and the environment from the dangers arising from industrial accidents and catastrophes in emergency zones.

The accident at the Chernobyl nuclear power plant, the study of the causes of its occurrence, led to the emergence of a new concept: safety culture. According to documents of the International Atomic Energy Agency (IAEA) (INSAG-4, 1991), a safety culture (SC) is defined as a culture of work, in the organizational and individual aspects of which radiation safety issues, as having the highest priority, are given attention to their importance.

Organizational aspect — SC aspect, determined by the manager's commitment to the highest level of security priority, reflected in the statement in the field of security policy, specific actions to create organizational structures and separation of powers, regular review of processes affecting the security. The individual aspect is the aspect of SC, determined by the awareness by employees of the highest priority of safety in their actions by rigorous implementation of all regulatory documents and instructions on radiation safety.

The procedural aspects of SC assessment are related to expert missions. The work of the ASCOT (ASCOT, 1994) and SCART (SCART, 2007) missions is based on bypasses of nuclear power plants, discussions with company management and staff on issues regulated by IAEA documents. After that, the mission gives an expert opinion on the level of safety culture at this enterprise.

In the IAEA documents, among the many relevant characteristics of a safety culture, three were selected as key (INSAG-4, 1991; INSAG-15, 2002): a) commitment to the ideas of safety priority of senior management; b) the availability of competent personnel of sufficient strength; c) openness and sociability. But the management and control functions on the part of management to increase the design bureau will not give the expected effect if the individual aspect of design bureau is not worked out: the attitude to safety and the adequacy of the behavior of each employee when the employee is left alone with problems at his workplace (Abramova, 2011).

This requires complementing external missions with an "internal" SC assessment. For this purpose, a methodology was developed (Bobrov et al., 2017), which ensures the assessment of design bureau at the enterprise by its employees. The indicators recommended by the SCART mission (SCART, 2007) were used as characteristics and signs of a safety culture. The assessment is carried out using the questionnaire, which includes 111 questions. The experts are senior managers, middle managers of the enterprise and its employees.

However, the methodology does not provide an opportunity to assess the degree of sincerity of the responses of experts. This reduces the reliability and reliability of the SC assessment. The unique opportunity of vibraimage technology to evaluate the unconscious human response used in profiling and psychological testing systems (Minkin, 2007; 2020; Minkin&Nikolaenko, 2017) makes it possible to solve this problem.

The aim of the study was to develop a methodology for the "internal" safety culture assessment of enterprises performing work with spent nuclear fuel and radioactive waste, taking into account the unconscious response of the person being tested to the questions posed by vibraimage technology.

## Methodological issues of assessing safety culture by controlling unconscious responses of testee

When developing the questionnaire for the "internal" assessment of SC, indicators recommended by the SCART mission (SCART, 2007), including 5 integral characteristics (blocks), were used as characteristics and signs of a safety culture:

A. Security as a clearly recognized value.

B. Evidence of safety priority at all levels of government.

C. Clear allocation of responsibilities.

D. Continuous improvement of professional knowledge by employees for the safety of the organization.

E. Safety is included in all activities.

Evaluation of each characteristic is carried out by presenting 6 questions. For example, for block A, one of the questions has the following wording: Do you know about the official statement of the SevRAO leadership about the priority of security over material and other issues of the organization of work? For block B: is the priority attitude to security reflected at all levels of enterprise management in the criteria included in the overall assessment of the enterprise? For block C: are the functional responsibilities of personnel and the level of their compliance with accepted standards and procedures clearly defined and unambiguously understood? For block D: do you think that the desire to improve professional knowledge and skills is characteristic of personnel of all categories? For Block E: Does the enterprise have a system for monitoring the status of all types of safety, including labor protection, environmental safety and social security? Answer options: yes/no.

A quantitative assessment of the integral characteristics of the A-E safety culture was carried out using 2 algorithms.

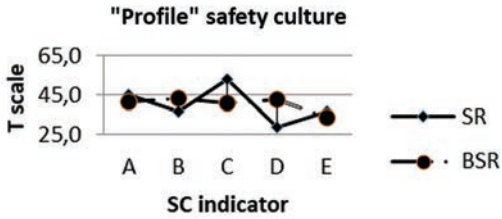
The first is developed by specialists of the FSBI SSC FMBC them. A. I. Burnazyan FMBA of Russia on the basis of a training sample constructed by modeling the full space of events: all theoretically possible combinations of answers to the questions posed. Similarly to what was done in the work (Bobrov et al., 2017), using the methods of multivariate statistical analysis, criteria for the integrated assessment of the A-E characteristics of the safety culture and decisive identification rules for the tested high, medium or low SC level were developed.

The second algorithm was developed by specialists from the Elsys Corp, St. Petersburg, Russia. It allows you to evaluate the conscious, unconscious and total response of the safety culture tested by the characteristics of A-E.

## Presentation of safety culture assessment results

The main results of the safety culture assessment include an assessment of the conscious and unconscious reactions calculated using the algorithms of the Elsys Corp (fig. 1a). This allows not only to evaluate their values / severity for each of the indicators of safety culture A-F, but also to visually assess their difference in reaction. A large negative difference indicates insincerity and / or test takers' choice of a socially approved answer (Minkin&Nikolaenko, 2017).

The evaluation results also include the values of the total profile, estimated according to the algorithms of the FMBC named after A. I. Burnazyan in T-scale and according to the algorithms of Elsys Corp in % (fig. 1b). In addition, a decision is issued on the need for measures to increase the level of design bureaus for specific indicators: "–" events are not required, "+" events are required. The decision is issued with low values of the indicator, large negative values of the difference between the conscious and unconscious reactions, or with a combination of these signs.




a

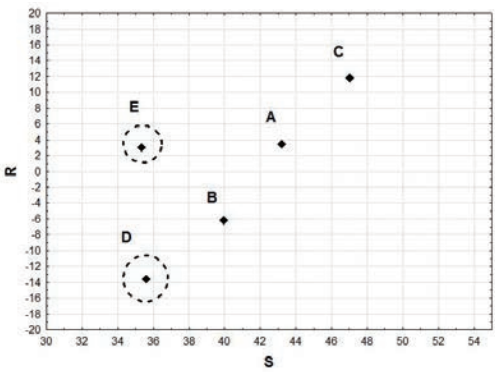
| SC indicator | T scale | % | CR-UR (R,%) | Action |
|---|---|---|---|---|
| A | 50,0 | 43,2 | 3,4 | – |
| B | 41,9 | 40,0 | –6,2 | – |
| C | 58,1 | 47,1 | 11,8 | – |
| D | 33,8 | 35,6 | –13,6 | + |
| E | 46,9 | 35,4 | 3,0 | + |

b

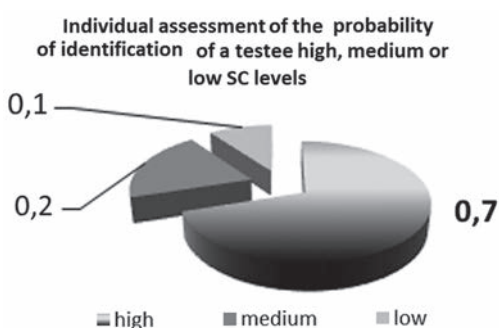
**Fig. 1. a** — value of indicators (A-F) according to the assessment of conscious (CR) and unconscious (UR) reactions; **b** — the values of indicators (A-F) in the T-ball and % scale, the difference between conscious and unconscious reactions (R) and the need for action to increase SC ("–" are" not required, "+" are required)

SC indicators presented in the table in figure 1b are displayed as a "lattice" of the safety culture (fig. 2a) (Bobrov et al., 2017). The abscissa axis represents the values of the total reaction (S, %), the ordinate axis represents the difference between the conscious and unconscious reactions (R, %). The dashed line indicates "growth points": weaknesses in the organization of work at the enterprise, which should be addressed first. They are allocated in accordance with the above rules.

The test results also assess the likelihood of identification of the tested high, medium or low SC level. The assessment is carried out according to the algorithms of FMBC them. A. I. Burnazian (fig. 2b).




a




b

**Fig. 2. a** — "lattice" of safety culture, S — total reaction (%), R — difference between conscious and unconscious reactions for indicators (A–F); **b** — individual assessment of the probability of identification of a testee high, medium or low SC levels

## Conclusion

World experience shows that the development, legislative approval at the industry or state level of standards that ensure the safety of objects of various sectors of the economy and the environment, largely depends on the person who is called upon to comply with these rules.

The simplest example is the automotive industry. No matter how perfect the rules of the road, the infrastructure of roads, the safety of vehicles, the number of traffic accidents with serious consequences will not decrease, if the attitude of drivers towards safety does not change as the highest priority in traffic. It manifests itself in the refusal to take alcohol and narcotic drugs while driving, in road behavior, maintaining the technical condition of cars, etc. In other words, in the culture of driving, a culture of behavior on the road, a culture of observing traffic rules, etc. All these characteristics can be united in the concept of road safety culture.

Therefore, the methodology and criteria for an "internal" safety culture assessment developed for enterprises engaged in the management of spent nuclear fuel and radioactive waste can be in demand not only for other enterprises in the nuclear industry, but also for any enterprises with potentially dangerous technologies. The specifics of the enterprise should be taken into account in the wording of the questionnaire. Vibraimage technology provides the requested processing algorithm for any options of questionnaires.

### References:

1. Abramova, V. N. (2011). Organizational psychology, organizational culture and safety culture in nuclear energy. (Part 2). Moscow-Obninsk.
2. Bobrov, A. F. et al. (2017). Assessment of safety culture at spent nuclear fuel and radioactive waste management enterprises, Hygiene and sanitation, 96 (9).
3. Minkin, V. A. (2017). Vibraimage. St. Petersburg: Renome. DOI: 10.25696/ELSYS.B.EN.VI.2017
4. Minkin, V. A. and Nikolaenko, Y. N. (2017). Vibraimage and Multiple Intelligences. St. Petersburg: Renome. DOI: 10.25696/ELSYS.B.EN.VIMI.2017
5. Minkin, V. (2020). Vibraimage, Cybernetics and Emotions. St. Petersburg: Renome. DOI: 10.25696/ELSYS.B.EN.VCE.2020
6. ASCOT (1994). Assessment of Safety Culture in Organizations Team IAEA-TECDOC-743/R, Guidance on Self-Assessment of Safety Culture and ASCOT Group Mission. IAEA, Vienna.
7. INSAG-15 (2002). Key issues in improving safety culture. Report of the International Nuclear Safety Advisory Group. INSAG-15, IAEA, Vienna.
8. INSAG-4 (1991). Safety culture. Report of the International Nuclear Safety Advisory Group. INSAG-4, IAEA, Vienna.
9. SCART (2007). IAEA SCART GUIDELINES. Reference report for IAEA Safety Culture Assessment Review Team (SCART), Vienna.