

## THE ANALYSIS OF THE HUMAN FACTOR INFLUENCE ON THE EFFICIENCY OF POWER SYSTEM MANAGEMENT

*Nan Feng\**, *O. M. Shikulskaya\*\**, *O. B. Urumbaeva\*\*\**

*\*Transport construction institute*

*of the Shandong transport university Shan Dong (China),*

*\*\*Astrakhan state university of architecture and civil engineering (Russia)*

*\*\*\*Astrakhan State Technical University (Russia)*

В данной статье раскрыта проблема влияния человеческого фактора на надежность и безаварийность работы энергетической сети. Были рассмотрены три главных группы причин опасных ситуаций и несчастных случаев. Это нарушения мотивативные, показательные и исполнительные производства. Выполненный анализ позволяет создавать модель, которые формализуют влияние человеческого фактора на надежность сети власти с числовым использованием методов и уменьшать это отрицательное влияние.

**Ключевые слова:** безопасность, человеческий фактор, сбой, энергичная сеть, профессиональный отбор, опасность.

In this paper the problem of human factor influence on reliability and fail-safety of power network is discovered. Three main causes groups of hazardous situations and accidents have been reviewed. These are violations of motivative, indicative and executive actions. Performed analysis allows to create the model which formalize the human factor influence on reliability of power network with numeric methods using and to reduce this negative influence.

**Keywords:** safety, the human factor, failure, energetic network, professional selection, danger.

The amount of man-made catastrophe has been increased dramatically since 1980s. This growth relates to technology progress and increasing influence of human being on nature [1].

Electroenergetic systems are characterized by long equipment lifetime. Pre-dominance of obsolete equipment and poor quality of new devices might increase unit load on electrical equipment, thus increasing probability of equipment failure. The actual workload of operational personnel might increase as well due to this. This leads to enhance the role of operational personnel related to preventing technological violations which might subsequently lead to accidents and failures.

The most important task of any operational group is human safety. Risk analysis should provide detailed description of possible consequences of accident. Potential personnel, human and environmental losses must be properly evaluated before preventing measures planning.

Management and situation control is considered as important factor as well. The feeling of danger can be decreased by controlling the situation, for example, when a person takes a risk on a period of time intentionally. Another important factor is possible severity of consequences. Personnel can take more risk in case of supervising presence. Thus, definition a "subjective risk" is appeared. Proper balance between risk and benefit should be developed for clear differentiation of subjective and objective risks [2].

Right combination of using personnel competence and modern devices allows significant increasing in work efficiency and promotes technical equipment optimization.

Human factor is expressed as a failure in identification and evaluation of hazardous situations and an inability to make appropriate decisions in dangerous situations. The presence of certain individual psychological features causing accidents is one of the reasons of human factor existence. These features are reaction, concentration, attention, logical thinking, emotional stability etc. That is why mistakes which are connected to human factor often relates to operational personnel who have psychophysiological disabilities [3]. Thus, the problem of cause evaluation and impact of negative influence of human factor in hazardous situations and accidents occurring is quite actual.

PJSC “MRSK Yuga – Astrakhanenergo” – the subsidiary company of PJSC “Rosseti”, leading electro energetic company in Russia, was chosen to analyze the impact the psychophysiological state of individuals. The company has got 2.34 billion kilometers of power lines, 502 thousand of substations with total transformer power is about to 781 thousand of MW. PJSC “Rosseti” is consisted of 36 subsidiary companies including 14 interregional network company.

Annually, the number of technological violations related to operational personnel errors in PJSC “Rosseti” make up about 4% of the total number of violations. 221 technological violations related to operational personnel errors happened from January 2013 to July 2017 in PJSC “Rosseti” (fig. 1).

Technological violations related to personnel wrong decisions in PJSC “MRSK Yuga – Astrakhanenergo” which has occurred during 2013-2017yy are grouped by types of violation.

It was established that 50% of wrong decisions which lead to technological violations made by operational personnel, 22% of mistakes relate to personnel servicing substation and devices of relay protection and automation and 6% of wrong decisions relate to personnel servicing power cable lines (fig. 2).

It is proposed to consider human factor from three points of view [4]:

1) Mindset according to which any event is considered as its functioning product. That can be related to the personnel mistakes during job execution.

2) Mechanism which provides reliable functioning based on consideration of psycho-physiological capabilities and limitations of specialists who create and operate machinery and equipment. It allows to apply optimal ergonomic characteristics and to exclude any consequences which can lead to mistaken decisions.

3) Tool which allows investigation of catastrophic event (destroying, incidents, road accidents etc).

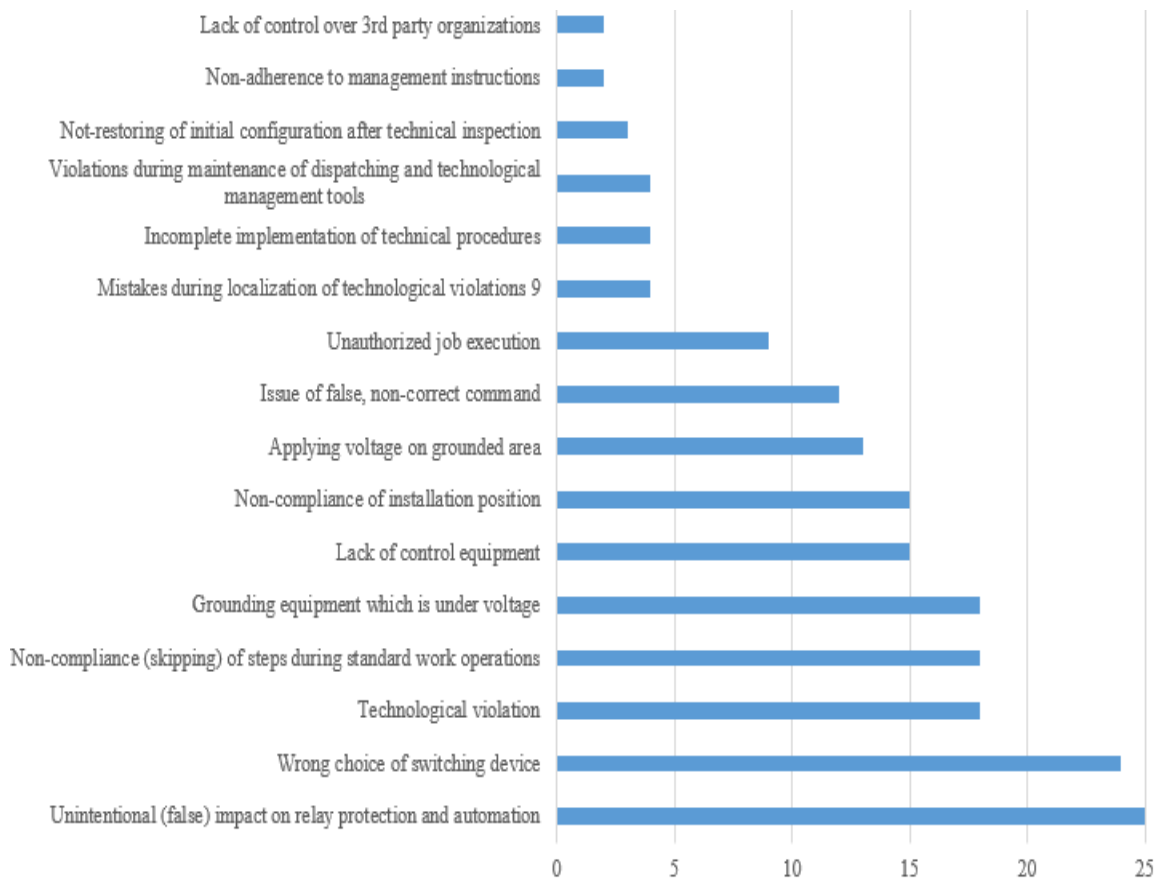


Fig. 1. The reasons of technological violations related to personnel wrong decisions

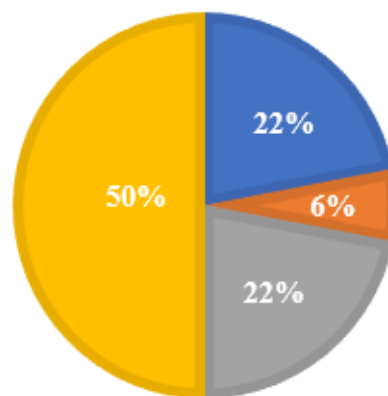
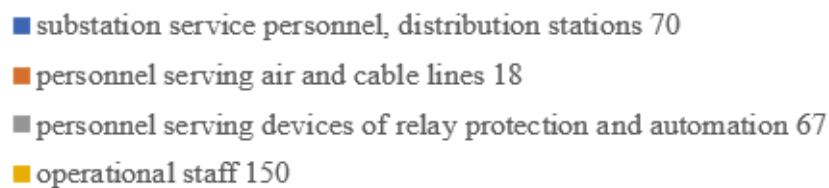


Fig. 2. Diagram of wrong decisions divided by personnel category

Human factor is considered as personnel ability indicator to perform tasks reliably and in timely manner.

It is proposed to perform evaluation and analysis of human factor by using of three variables:

1) Actual and required number of industrial personnel to perform complex of task for safe operation of hazardous production facility (HDF).

- 2) The number of competent personnel for certain type of work.
- 3) Number of personnel wrong decisions relating to industry safety requirements

The following factors are important for reliable production performance of operational personnel: personnel's qualification, psychological features, health condition and mental capacity.

There are 3 functional parts of human actions: motivative, executive and indicative. Wrong decision in any part of actions can lead to entirely wrong action which subsequently can lead to appearance of hazardous situation or accidents. Based on this fact, it is proposed to highlight 3 main reasons of hazardous situation and accidents appearance [5]:

1) motivative violation is characterized by absence of desire to perform certain tasks, for example, worker is prone to risks or his attitude to labor and technical regulations is completely negative;

2) executive violation is described as non-adherence to rules, instructions and standards due to non-compliance of psychophysiological abilities to job requirements. For example, insufficient coordination, poor attention and memory, disability and health deterioration;

3) indicative violation is considered as absence of competency to perform certain job task due to poor professional training. It is characterized by lack of knowledge in operating technical systems and applying safety rules during the job execution. Prevention of indicative violations is the most efficient measure for hazardous situations and accidents reduction. This enables to conduct professional operational personnel selection and reduce possibility of operator's wrong decisions.

The modernization of technical system functioning is facilitated by three factors:

1. compliance of individual abilities of an employee with professional requirements;
2. continuous knowledge improvement in certain type of activity;
3. optimal management system planning.

Professional selection is considered as prognosis of professional suitability and as choice of job profiles on its basis, the requirements of which correspond to the individual characteristics of a person [6].

The concluding stage of professional selection execution is consisted of analysis and correct results processing of psycho-physiological assessment and evaluation of professional suitability.

Performed analysis allows to create the model which formalize the consideration of personnel's qualification, psychological features, health conditions, mental abilities with application of numeric methods and to reduce negative impact of human factor on reliability of energetic network performance.

### References

1. Voropai N. I, Osak A. B. Future of electroenergetic systems. Moscow, journal "Energetic politics" № 5. 2014. 60–63 p.
2. Alekseev A. K., Perfilova E. A. Technical decisions for increasing of efficiency and reliability of operator's duties. Lipetsk, international scientific and practical conference "Energetic and ergoeffective technology", 2010.

3. Shindovskiy E., Shyurts O. Statistical management methods quality: Control cards and control plans. M. : World Publ., 1976. 597 p.
4. Kristensen Zh., Meyster D., Fouli P. The human factor. Ergonomics complex scientific and technical discipline. M. : World Publ., 1991. 599 p.
5. Khitosi K., Adler Yu. P., Konarev L. A. Statistical methods of improvement of quality. Moscow, Finance and statistics Publ., 1990. 304 p.
6. Alekseev A. K., Psychophysiological factors defining operator's action, MGOU, XXI. New technologies., 2010. № 6

УДК 004.896

## THE SCHEMES SYNTHESIS FOR DRINKING WATER PURIFICATION

*M. Saleh\**, *A. E. Usynina\*\**, *O. M. Shikulskaya \*\*\**

*\*KTH Royal Institute of Technology (Sweden),*

*\*\* Astrakhan state university of architecture and construction (Russia),*

*\*\*\* Astrakhan state university of architecture and civil engineering (Russia)*

Авторы статьи обосновали необходимость информационно-аналитической поддержки специалистов при принятии технических и управленческих решений по оптимальному выбору технологических схем очистки питьевой воды, выбрана и обоснована среда разработки, предложены проектные решения по созданию базы данных и пользовательского интерфейса для решения синтеза технологических схем очистки питьевой воды.

**Ключевые слова:** *очистка, питьевая вода, технологическая схема, синтез, анализ, база данных.*

Authors of paper proved need of information and analytical support of experts at acceptance of technical and administrative solutions at the optimum choice of technological schemes of drinking water cleaning, the development environment is chosen and proved, design solutions on creation of the database and the user interface for the solution of synthesis of technological schemes of cleaning of drinking water are proposed.

**Keywords:** *cleaning, drinking water, technological scheme, synthesis, analysis, database.*

The ecological condition of water resources of the majority of regions of the Russian Federation is near-critical or critical. Environmental protection, rational use and reproduction of natural resources, maintaining their biological diversity is one of the most relevant tasks of modern society. The pure problem occupies one of the major places in the solution of this task as a surface water is the most sensitive link of the environment. The major factors exerting negative impact on the level of rationality of use of water resources are use of outdated water capacious production technologies, insufficient degree of equipment of water intaking constructions the systems of instrument account and so forth. The problem requiring special attention is the remaining high level of negative anthropogenic impact on water objects.

In the conditions of not decreasing anthropogenic loads of water sources, insufficient financing on commissioning of new capacities of water supply systems, increases in requirements to quality of drinking water the special relevance is acquired by a problem of the choice of methods of processing of water at design new and reconstruction of the existing stations of preparation of water [1].