**European Journal of Clinical Pharmacy**
**Print ISSN:** 2385-409X **Online ISSN**: 3105-0409
Website: https://farmclin.com/

*Original Research Article*

# Lighting of the reactor and nuclear power plant of the object by rotation (chain connection) method

***Article History:***

**Received**: 12-11-2025
**Revised**: 26-11-2025
**Accepted**: 09-12-2025
**Published**: 23-12-2025

**Name of Author:**
E. H. Bozorova[1], R. B. Batirova [2], D.A Vaxobov [3]
*

***Affiliation:*** *[1] Institute of Nuclear Physics Academy of Sciences of the Republic of Uzbekistan, Tashkent, 100207 Uzbekistan.*
*[2]Fergana State Technical University, 150100 Uzbekistan*
*[3] Fergana State Technical University, 150100 Uzbekistan*



***Abstract***: This article analyzes the relevance and scientific-theoretical basis of the problem of educational methods, and presents the content and essence of the classification of educational methods, theoretical and practical bases in teaching teachers. Also, in the article, the preliminary control results of experimental work and the advantages of the rotary (chain link) method, the method and technique of the rotary method and the activity of learners during the training process, the nuclear reactor used in nuclear power plants, in order to increase the effectiveness of quality education and extractable electrical energy factors are discussed.

*Keywords*: Circulation, scientist, pedagogue, learner, activity, result, quality, electricity, reactors, atom, water, active zone, object.

## INTRODUCTION

The educational model of our country is not limited to the establishment of educational institutions that meet the most modern requirements, this model is primarily based on quality, that is, on improving the quality of teachers, pupils, students, educational programs and, ultimately, knowledge. In addition, this educational model, developed taking into account the needs related to globalization, serves as a means to ensure that our country occupies a worthy place in Asia and in the world community in general. the quality and efficiency of education increased dramatically. The material and technical bases of educational institutions have been strengthened. It can be said with satisfaction that the introduction of modern education system is giving positive results today. Now, the task of us pedagogues is to educate our youth on the basis of innovative educational technologies at the level of requirements in educational institutions with modern technical equipment [1-6].

Pedagogical system is now able to convey great innovations and changes through extensive use of various innovative information technologies and interactive methods, and thus independent thinking in the minds of students, correct acceptance of current changes and rational decision making. teaches to do. Currently, in such a time when the development of science and technology is flourishing in our country, there are many talented scientists and students who want to further develop innovative technologies, pedagogical skills of educators and science teachers are involved. Among the foreign and domestic scientists who contributed to the development of science and technology, the following outstanding persons are Oynisa Musurmonova, Doctor of Pedagogical

 

Sciences, Professor. Norboy Artikov, doctor of pedagogical sciences, professor, Abdukadirov Abdukakhhor, Abdukakhhor Abduvakilevich, I.P. Podlasi, professor, Azarenkov N.A., Bulavin L.A., Zalyubovsky I.I., Krichenko V.G., V.D. Simonenko, V.A. Slastenin Ravshan Ishmukhamedov, Maksudjon Yuldashevb, O.D. Rakhimov, O.M. Turgunov, Q.O. Mustafaev, H.J. Rozhiev and Azizkhojayeva N.N, Shukolyukov A. Yu Sodikov.I.I, Mullaboev K.Yu, economic by N.I. Novikov, V. Vlasenko, V.N. The role and contributions of Myasishev, L.M. Fridman are incomparable[7-12].

## RESULTS AND DISCUSSION

Today, the pedagogue conducts a lesson using innovative modern media and pedagogical methods in order to ensure that the audience, i.e. the learners, focus their attention on the topic under study (for example, the topic "Reactor and Atomic Power Station"). training is the main prelude to the introduction of a quality education system in the field of pedagogy. Enlightening the lessons through different methods is the most important factor in increasing efficiency, one of these methods is the "Rotation (chain connection)" method.

The rotation (chain connection) method is to ensure the organic connection between the teacher and the students. In this method, there are circular logical chain links, which are listed below:

- the teacher directly with the student,
- student with teacher,
- the pedagogue presents the student with the topic under study (for example, the topic "Reactor and Nuclear Power Plant"),
- by the method used by the student,

And connecting the -method with the topic creates a logical circular link. At the same time, both the teacher and the student are active in the audience, and the motivation of the teacher and the student is at a high level. high efficiency of mastering the studied topic by students, provides students with the ability to know, understand, and analyze the studied topic, as well as activity in the audience. Below, we describe the method of rotation (chain connection) as an example of the topic "Reactor and Nuclear Power Plant" as follows:

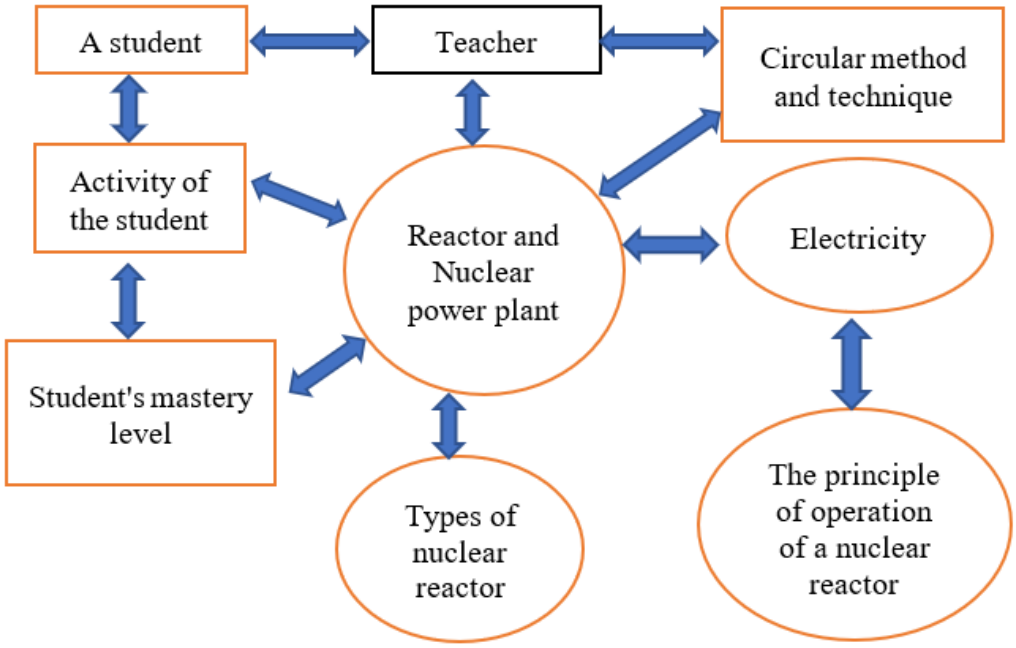


**Fig. 1.** Expression of the rotation (chain connection) method on the example of the topic “Reactor and Nuclear Power Plant”.

Information on the topic "Reactor and Reactor and Nuclear Power Plant" through the method of rotation (chain connection) is presented to students of groups 50-21 EE and 51-21 EE of the Faculty of Energy of Fergana Polytechnic Institute:

The following questions were asked in order to check students' initial understanding and knowledge of the topic "Reactor and Nuclear Power Plant".

-Do you know radioactive elements?
- Enriched uranium?
- Can you make a chain reaction?
- What kind of device is a reactor?
- Give the difference between neutrons and protons?
- How do slow and fast neutrons differ in energy?

-Explain the flow rate of hot neutrons?
- Can you tell the characteristics of the reactor according to its application?
The results of the students' answers to the questions are presented below based on the table and diagram:

**Table 1.** Preliminary results from students

| **Experience stage and academic year** | **Educational institution** | **Number of students** | | **Degree (mastery)** | **Experience in the group (%) at the expense of** | **Control in the group (%) at the expense of** |
|---|---|---|---|---|---|---|
| | | Experience group | Control group | | | |
| **2021-2022 academic years** | **Fergana Polytechnic Institute** | **Electric energy 50-21 EE group, 25 people** | **Electric energy 51-21 EE group, 27 people** | high (excellent) | **(29.0%)** | **(30.0%)** |
| | | | | medium (good) | **(33.0%)** | **(38.0%)** |
| | | | | Low (satisfactory) | **(38.0%)** | **(32.0%)** |

| Questions | Experiment 50-21 Group EE | | | Control 51-21 Group EE | | |
|---|---|---|---|---|---|---|
| | At the beginning of the experiment | | | At the beginning of the experiment | | |
| | High (%) | on account of Middle (%) | Low in account (%) at the expense of | High (%) | on account of Middle (%) | Low in account (%) at the expense of |
| Question 1 | 32 | 31 | 33 | 28 | 35 | 25 |
| Question2 | 26 | 29 | 44 | 26 | 41 | 32 |
| Question 3 | 27 | 33 | 44 | 27 | 40 | 31 |
| Question 4 | 31 | 33 | 38 | 34 | 43 | 33 |
| Question 5 | 33 | 32 | 36 | 33 | 33 | 38 |
| Question 6 | 25 | 31 | 43 | 32 | 44 | 29 |
| Question 7 | 24 | 37 | 32 | 27 | 33 | 35 |
| Question 8 | 34 | 38 | 34 | 33 | 35 | 33 |
| Overall percentage | 29.0% | 33.0% | 38.0% | 30.0% | 38.0% | 32.0% |

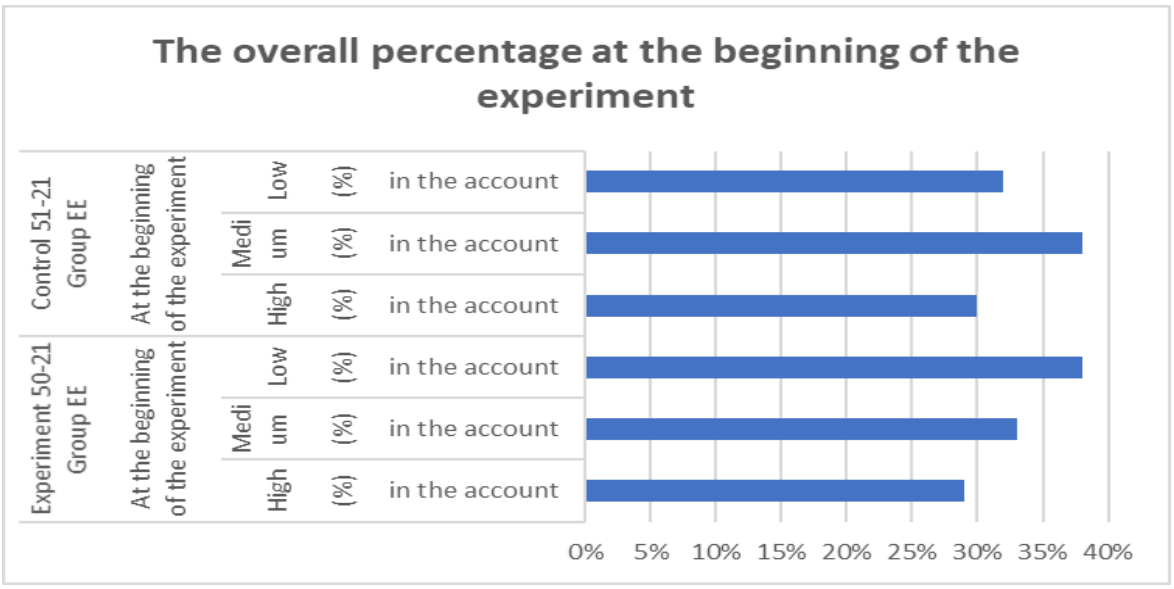


**Fig.2.** Diagram view of preliminary results obtained by students

Based on the results obtained, the following method was provided with the method of "circulation (chain connection)" to students.

It is known that the atom power plant works on the basis of the reaction formed as a result of its separation from the atomic nucleus. In this process, mainly uranium or plutasium atoms will take part in this process.

In the AES to use uranium, Uranian ore is made to the powder. The uranium powder is brought to the view of the metal "tablets" then pressed tablets are burned at 1,500 degrees temperatures. Uranus tablets are used at a single reactor about 10 million processed uranium tablets [13-15].

It is known that the atomic nuclei secrete neutrons and as a result, neutrons form new neutrons and huge kinetic energy particles. The selection of the cinema is the basis of the energy station. During the reaction reactor, the energy that is separated during the reaction becomes heat and the heat passes on to the heat[15-17].

Then, the temperature in the heat carrier passes through special heat exchangers to ordinary water in the second circuit and boils it.

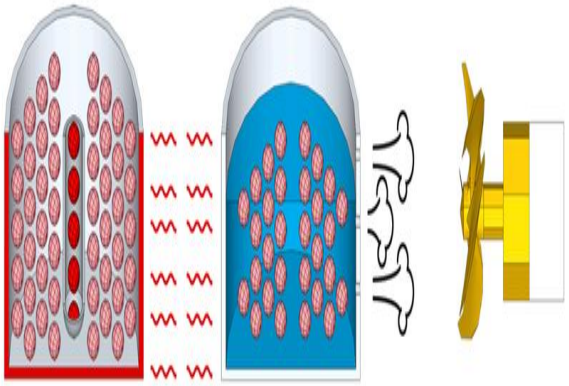

**Fig. 3.** The principle of operation of the reactor at the NPP.

The steam produced by boiling turns the turbine. The turbine drives a generator that produces electricity [26].

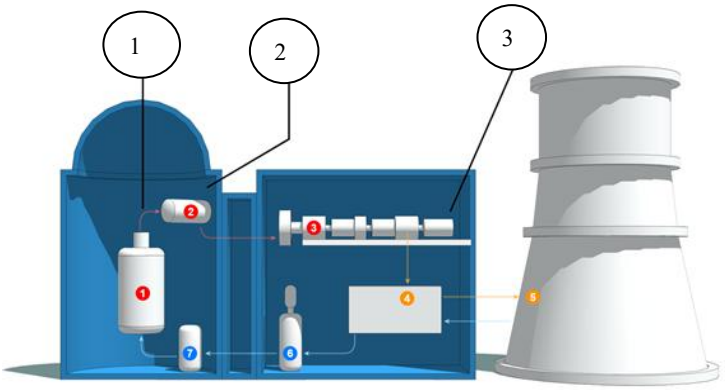


**Fig. 4.** General kinematic view of the nuclear power plant[19]

1. The main element of the reactor is the active zone. The active zone is located in a concrete mine. Mandatory components of any reactor are the control and protection system that allows the continuation of the selected mode of controlled fission chain reaction, emergency protection systems to quickly stop the reaction in emergency situations, and all are installed in the main building.

2. There is also a second building that houses the turbine hall (2): steam generators, the turbine itself. Next in the technological chain are capacitors and high-voltage transmission lines, which are located outside the station area.

3. The site has a facility for reloading spent nuclear fuel and storing it in special pools. In addition, the stations are equipped with elements of a circulating cooling system - cooling towers (3) (a concrete tower that tapers upwards), a cooling pond (a natural or artificially created reservoir) and spray ponds [24].

The single-circuit circuit is used in nuclear power plants with reactors of the RBMK-1000 type. The reactor operates in a unit with two condenser turbines and two generators. In this case, the boiling reactor itself is a steam generator, which allows the use of a single-loop circuit. The single-cycle scheme is relatively simple, but in this case, radioactivity applies to all elements of the block, which means that biological protection is very complicated [25].

The single-circuit circuit is used in nuclear power plants with reactors of the RBMK-1000 type. The reactor operates in a unit with two condenser turbines and two generators. In this case, the boiling reactor itself is a steam generator, which allows the use of a single-loop circuit. The single-cycle scheme is relatively simple, but in this case, radioactivity applies to all elements of the block, which means that biological protection is very complicated.

**NPP WITH 2 RING REACTORS**

The two-circuit scheme is used in nuclear power plants with water-cooled reactors of the VVER type. Pressurized water is supplied to the reactor core, and then the supplied water is heated. The energy of the coolant creates saturated steam in the steam generator. The second scheme is not radioactive. The unit consists of one 1000 MW condensing turbine or two 500 MW turbines with coupled generators [26].

**3- NPP WITH RING REACTORS**

The three-ring scheme is used in nuclear power plants with sodium-cooled fast neutron reactors of the BN type. To exclude the contact of radioactive sodium with water, a second circuit is built with non-radioactive sodium, and as a result, the circuit turns out to be three-contact [27].

In order to strengthen the understanding of the students and evaluate their knowledge, they were addressed with the following questions;

-What is a chain reaction?
- What kind of device is a reactor?
-Do you know radioactive elements?
- Can you tell the difference between the energies of fast and slow neutrons?
-Can you tell me the types of reactors?
- Can you tell me the principle of operation of the reactor?
- What do you know about AES?
- Advantages of NPP?

The results obtained are as follows;

**Table 2.** The result obtained from the students at the end of the experiment

| Questions | Experiment 50-21 Group EE | | | Control 51-21 Group EE | | |
|---|---|---|---|---|---|---|
| | At the beginning of the experiment | | | At the beginning of the experiment | | |
| | High (%) | on account of Middle (%) | Low in account (%) at the expense of | High (%) | on account of Middle (%) | Low in account (%) at the expense of |
| Question 1 | 41 | 35 | 24 | 32 | 41 | 26 |
| Question2 | 42 | 39 | 18 | 30 | 38 | 30 |
| Question 3 | 46 | 38 | 16 | 28 | 40 | 31 |
| Question 4 | 45 | 39 | 15 | 33 | 35 | 29 |
| Question 5 | 45 | 40 | 14 | 41 | 33 | 28 |
| Question 6 | 44 | 33 | 24 | 29 | 34 | 36 |
| Question 7 | 41 | 38 | 21 | 31 | 37 | 36 |
| Question 8 | 4ф0 | 34 | 28 | 40 | 38 | 24 |
| Overall percentage | 43.0% | 37.0% | 20.0% | 33.0% | 37.0% | 30.0% |

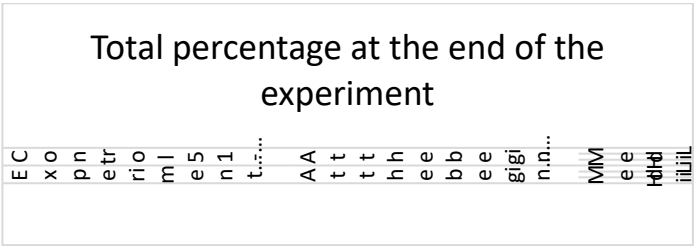


**Fig. 5.** A diagram of the results obtained from the students at the end of the experiment

Based on the results presented above, students were able to fully understand the topic of "Reactor and Reactor and Nuclear Power Plant" using the "Circulation (chain connection)" method;

-Students remembered the topic "Reactor and Nuclear Power Plant" well;

- They mastered each process on the topic "Reactor and Reactor and Nuclear Power Plant" at a high level through chaining;

-Students' understanding of pedagogical technologies and educational tools was expanded;

-students independently found solutions to problematic situations related to the topic;

- timely continuity of communication was ensured;

- Conditions were created for the practical application of concepts;

- Various forms of teaching methods were offered;

- The motivation of teachers and students was at a high level;
- The improvement of the communication skills of students;
- The logical thinking of students increased;
- Achieved results such as efficient use of time

## CONCLUSION

In order to build a great country in the future, we need leaders and specialists who have a different worldview, deeply pure thinking, educated, capable, high-minded, well-developed thinking. For this, it is important to develop a high-quality education system in accordance with the requirements of the times and enthusiasm in the education system. For this purpose, conducting lessons based on modern methods and innovative technologies has been fully implemented in the educational process in our country. This is the most important factor guaranteeing high efficiency. When we use the above-mentioned interactive education method, the students' thorough mastery of the taught subject and high level of recall were expressed through statistical results. The high motivation and activity of students, as well as ensuring the organic relationship between the teacher and students, had a great impact on improving the quality of education. Based on the use of this method in education, it is possible to use it for technical subjects.

**FUNDING**

This article №. AM-PZ-2019062031 was written on the basis of the pedagogical analysis of the materials prepared within the framework of the innovative project "Creation of multimedia textbooks for bachelors and masters in the fields of "Nuclear energy", "Nuclear medicine and technologies", "Radiation medicine and technologies". and we thank the authors of the textbooks.

## REFERENCES

1. Yadernaya energetika:Uchebnoe posobie Azarenkov N. A., Bulavin L. A., Zalyubovsky I.I., Kirichenko V. G., Neklyudov I. M., Shilyaev B. A. - X. XNU's name is V. N. Karazina 2012. 535 p.
2. Akatov A. A., Koryakovsky Yu. S. Budushchee nuclear power plant. Reaktory na bystryx neutronax. — 2012. — 36 p.
3. Decision of the President of the Republic of Uzbekistan on measures to further develop the field of pedagogical education PQ-4623 27.02.2020
4. International nuclear association: official site. The regime is available at: http://www.world-nuclear.org/ State Corporation of Atomic Energy "Rosatom": official site. The regime is accessible: http://www.rosatom.ru/ Obzor nuclear technology — 2016:
5. Rakhimov N.O, A.S. Korolkov The place of information communications Far. 2018 year
6. Azizkhujaeva N.N. Pedagogical technologies and pedagogical skills. T.: CHulpan. 2013. - 200 pages.
7. Bozorov E.H. Jorayev M.Q. Stages of the development of nuclear energy development in the world of practical importance in innovative technologies. Article No. 12(79) (December, 2020).
8. Ryzhov S. B., Mokhov V. A., Vasilchenko I. N., Nikitenko M. P., Makhin V. M., Lapin A. V., Chetverikov A. E., Churkin A. N., Anikeev Yu. A., Shmelev S. V. VVVER – problematic issues in the active zone of SKD. Atomic Science and Technology. Series: Ensuring the safety of nuclear power plants. No. 3, 2009.
9. Lehr, Jay. "Nuclear energy: past, present and future." Energy & Environment, vol. 21, no. 2, 2010, pp. 97–102. JSTOR, http://www.jstor.org/stable/43734899. Accessed 14 Apr. 2023.
10. Morrow S. L., Koves G. K., Barnes V. E. Exploring the relationship between safety culture and safety performance in US nuclear power operations //Safety Science. – 2014. – T. 69. – C. 37-47.
11.G. Locatelli et all. Small modular reactors: a comprehensive overview of their economics and strategic aspects Prog. Nucl. Energy (2014)
12. Abdulla A., Azevedo I. L., Morgan M. G. Expert assessments of the cost of light water small modular reactors //Proceedings of the National Academy of sciences. – 2013. – T. 110. – №. 24. – C. 9686-9691.
13. American Society of Mechanical Engineers. American National Standards Institute. Standard for Level 1/Large Early Release Frequency Probabilistic Risk Assessment for Nuclear Power Plant Applications. – American Society of Mechanical Engineers, 2008.
14. Budnitz R. J., Rogner H. H., Shihab-Eldin A. Expansion of nuclear power technology to new countries–SMRs, safety culture issues, and the need for an improved international safety regime //Energy policy. – 2018. – T. 119. – C. 535-544.
15. Bisconti A. S. Changing public attitudes toward nuclear energy //Progress in Nuclear Energy. – 2018. – T. 102. – C. 103-113.
16. Budnitz R. J., Rogner H. H., Shihab-Eldin A. Expansion of nuclear power technology to new countries–SMRs, safety culture issues, and the need for an improved international safety regime //Energy policy. – 2018. – T. 119. – C. 535-544.
17.J. Serp J. et al. The molten salt reactor (MSR) in generation IV: overview and perspectives //Progress in Nuclear Energy. – 2014. – T. 77. – C. 308-319.
18. Richards J., Sabharwall P., Memmott M. Economic comparison of current electricity generating technologies and advanced nuclear options //The Electricity Journal. – 2017. – T. 30. – №. 10. – C. 73-79.
19. Portugal-Pereira J. et al. Better late than never, but never late is better: Risk assessment of nuclear

 

power construction projects //Energy Policy. – 2018. – Т. 120. – С. 158-166.
20. Pfenninger S., Hawkes A., Keirstead J. Energy systems modeling for twenty-first century energy challenges //Renewable and Sustainable Energy Reviews. – 2014. – Т. 33. – С. 74-86.
21. Olympios A. V. et al. On the value of combined heat and power (CHP) systems and heat pumps in centralised and distributed heating systems: Lessons from multi-fidelity modelling approaches //Applied Energy. – 2020. – Т. 274. – С. 115261.
22. Odenberger M., Johnsson F. Achieving 60% CO2 reductions within the UK energy system—Implications for the electricity generation sector //Energy Policy. – 2007. – Т. 35. – №. 4. – С. 2433-2452.
23. Markides C. N. The role of pumped and waste heat technologies in a high-efficiency sustainable energy future for the UK //Applied Thermal Engineering. – 2013. – Т. 53. – №. 2. – С. 197-209.
24. Lunz B. et al. Scenario-based comparative assessment of potential future electricity systems–A new methodological approach using Germany in 2050 as an example //Applied energy. – 2016. – Т. 171. – С. 555-580.
25. Rijpstra K. et al. Solution enthalpy of Po and Te in solid lead–bismuth eutectic //Journal of Nuclear Materials. – 2014. – Т. 450. – №. 1-3. – С. 287-291.
26. Chen H. et al. Conceptual design of a small modular natural circulation lead cooled fast reactor SNCLFR-100 //international journal of hydrogen energy. – 2016. – Т. 41. – №. 17. – С. 7158-7168.
27. Cacuci D. G. A heat transport benchmark problem for predicting the impact of measurements on experimental facility design //Nuclear Engineering and Design. – 2016. – Т. 300. – С. 12-27.
28. Li M. J. et al. The thermodynamic and cost-benefit-analysis of miniaturized lead-cooled fast reactor with supercritical CO2 power cycle in the commercial market //Progress in Nuclear Energy. – 2018. – Т. 103. – С. 135-150.
29. Xu R. et al. Thermal-hydraulic analysis code development for sodium heated once-through steam generator //Annals of Nuclear Energy. – 2019. – Т. 127. – С. 385-394.
30. Choudhury D., Lahiri S. Converter target chemistry–A new challenge to radioanalytical chemistry //Applied Radiation and Isotopes. – 2018. – Т. 137. – С. 33-40.

 