INTERNATIONAL JOURNAL OF FORMAL EDUCATION

Volume: 3 Issue: 9 | Sep–2024 ISSN: 2720-6874
http://journals.academiczone.net/index.php/ijfe

The Methods of Integration Training in the Field of Science "Nuclear Physics" "Nuclear Reactors"

Asror Ramazanov*, Kamiljan Tursunmetov, Erkin Bozorov
National University of Uzbekistan named after Mirzo Ulugbek
(Tashkent city, University Street, 4, 100174, Tashkent, Uzbekistan)

Abstract: This article describes in detail the principle of operation of the nuclear reactor of the nuclear power plant, as well as the conditions for carrying out a stable nuclear chain reaction and the types of nuclear reactors, types of nuclear fuel, integrative descriptions of materials and general characteristics of the nuclear power plant based on the requirements and conditions for the erection Also the nuclear reactor, its main parts, types of materials, requirements for them, their safety basis were interpreted. The possibilities and successes of the practical application of the AEs were highlighted.

1. Introduction

Human development is largely determined by the possibilities of energy production and use. Nuclear energy is the field of energy use for the purpose of obtaining electricity and thermal energy from nuclear energy (nuclear energy) and the field of science and technology, which is engaged in the theoretical development and implementation of methods and means of converting nuclear energy into electrical and thermal energy. The technical basis of nuclear energy is the nuclear power plant (AES). In addition, the source of energy is a nuclear reactor (nuclear reactor). In the case of nuclear decay reactions (nuclear reaction), thermal energy is released because of the fission of uranium and plutonium nuclei, which is then converted into electrical energy, as in ordinary thermal power plants. In the event of a decrease in the reserves of organic fuel (coal, gas, oil, peat), severe environmental pollution, the use of nuclear fuel for the energy supply of mankind is currently the most reliable and ecological method. Therefore, in most developed countries (USA, Great Britain, France, Canada, Japan, Germany, Sweden, Russia, India, Pakistan, as well as Iran, Bar, etc.).) intensive work is being done to absorb other sources of energy from heat and hydropower, including, above all, highly efficient methods of using nuclear energy. Scientific studies on nuclear energy in Uzbekistan have been and are being conducted at the Institute of Nuclear Physics of the Academy of Sciences of Uzbekistan.

The history of the development of various energy technologies shows that it often takes at least 25-30 years for the new technology to be released from production in the laboratory to the commercial level. It will be another 20 years before this technology has won an important place in the energy market. Many unconventional energy sources are still at an early stage of development, and some have reached the level of prototyping. It follows from this that for many decades the energy needs can be met only because of proven sources and currently available technologies.

While all our efforts should undoubtedly be directed to the development of all possible energy sources, it is a complete fact that fossil and nuclear fuels (to a lesser extent, hydropower) are the only significant opportunities open to mankind by the end of this century. Of course, this does not exclude the possibility of using solar energy or biomass under certain local conditions, but globally these types of energy in no way play an important role in world energy.

The science of nuclear physics is taught to undergraduate and graduate students in the fields of physics, medical physics [1]. However, since very few study hours are devoted to the topic, as well as the abundance of the required information and its coverage are not in demand in the pedagogical literature, we have tried to cover these topics in an integrative way in this article [2].

Volume: 3 Issue: 9 | Sep–2024 ISSN: 2720-6874
http://journals.academiczone.net/index.php/ijfe

2. Methods

The basis of the nuclear power plant (AES) is a nuclear reactor. A nuclear reactor is a device in which a controlled, self-sufficient chain reaction of the binding of nuclei of certain heavy elements is carried out under the action of neutrons in the nucleus. This reaction is a process of self-sustaining nuclear fission of uranium isotopes. Isotopes of other elements are under the influence of neutrons, which easily penetrate into atomic nuclei due to the lack of an electric charge. A nuclear reactor (atomic reactor, atomic boiler) is a device for carrying out a controlled chain reaction of an atomic nucleus. The nuclear reactor is used in industrial power generation, the generation of neutron flux in physical research, artificial radioactive isotopes, as well as in power generation in nuclear power plants [3]. The functional types of nuclear reactors are described in the form of integrations in Figure 1.

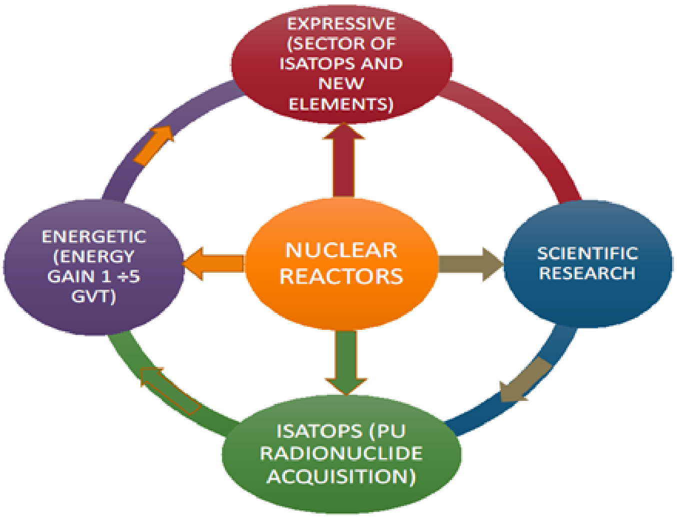

Figure 1. Functional types of nuclear reactors.

Depending on the speed of neutrons in the reaction, the nuclear reactor will be slow and fast and medium neutron reactors. Slow neutron reactors use a mixture of natural uranium isotopes or a mixture enriched with uranium (235U) as fuel. During the 235U splitting cycle, flying fast neutrons are attenuated with graphite or heavy water and converted to slow neutrons. In the case of a fast neutron reactor, no attenuator is used. In such a reactor, a chain reaction would have to be atomic fuel - pure 235U isotope or artificial isotopes 233u and 239ri (plutonium) - to get directly under the action of fast neutrons (Figure 2).

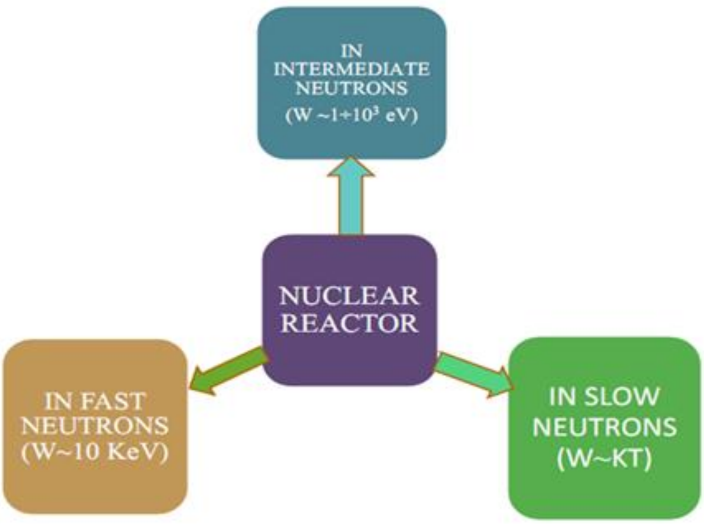

Figure 2. Descriptive types of nuclear reactors by neutron type.

Volume: 3 Issue: 9 | Sep–2024 ISSN: 2720-6874
http://journals.academiczone.net/index.php/ijfe

The chain reaction will continue only when the atomic fuel has a certain amount and volume, and when the calculated configuration is placed and the atomic reactor starts to work. In order to partially return neutrons leaving the reactor to the active zone, this zone is surrounded by a reverser (graphite or beryllium). The reverser allows a more extensive use of the neutrons produced in the active zone and a slight reduction in the reactor. In order for the reactor to work planar, it is necessary that the reaction proceeds in a norm, i.e. the number of neutrons No e (k-1)T / s in the law, the neutrons must be kept at an exact value in a state system in which the coefficient of ultrasonic increase is indicated. Otherwise, the reactor may come to a standstill or the number of neutrons flying away may increase, which will lead to the crash of the reactor. Therefore, neutron reversers are a system that keeps a certain number of neutrons in the active zone and ensures that the reactor operates in a norm [4]. This is an important part of the nuclear reactor. They consist of rods consisting of a variety of neutron absorbers (cadmium or boron). These rods are installed in the active zone of the reactor as excitable, and by moving, the reactor operating rhythm is selected. Once the fast neutrons emitted by the uranium are silenced, they degrade the other 238U atoms in the fuel [5]. As a result, the chain reaction proceeds without interruption.

Nuclear reactors are subjected to different tastings depending on the type of fuel used for this and are systematized in Figure 3.

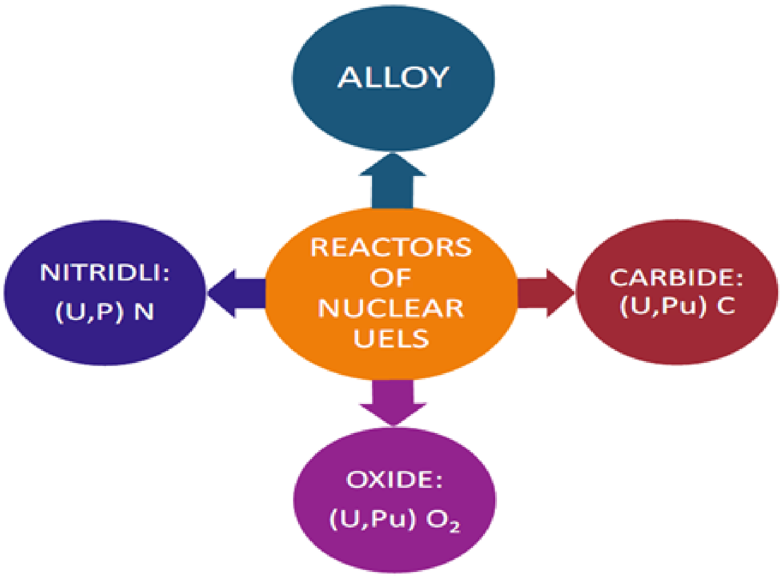

Figure 3. Integration classification of nuclear reactors depending on the types of nuclear fuels

The key elements of a nuclear reactor include:

- Nuclear fuel: isotopes of enriched uranium, uranium and plutonium and their compounds. The most commonly used type is the uranium-235U isotope and its compounds;
- Transfer energy that is generated when the reactor is running Working bodies: water, liquid sodium, etc;
- Responsive rods;
- Neutron moderator;
- Radiation protection coating.

In order to understand the principle of operation of a nuclear reactor and the principle of operation of a nuclear power plant, it is necessary to know the following components of the reactor and their activities and tasks:

Volume: 3 Issue: 9 | Sep–2024 ISSN: 2720-6874
http://journals.academiczone.net/index.php/ijfe

Active zone. This is the place where the nuclear fuel (heat release) and the moderator will be placed. Fuel atoms (often uranium fuel) undergo a fission chain reaction. Procrastinating factors: neutron repellents and retarders control the decay process so that the reaction can proceed at the desired rate.

Reflector of neutrons. The reflector surrounds the active zone. In some cases, a reflector can also be called a breeding zone. The main purpose of the reflector is to prevent the leakage of neutrons into the environment. In fact, this box, the main purpose of which is to return neutrons and prevent them from leaving the reactor and spreading into the environment.

The heat carrier of the moment. The coolant (liquid) must absorb the heat released during the fission of the fuel atoms and transfer it to other substances. Coolant mainly determines how the nuclear power plant is located. The most active heat carrier today is water.

Reactor control system. The nuclear power plant will consist of sensors and mechanisms that control the reactor. Of great importance is the separation of reactors according to their periodic and constant modes of operation. If no reagents are transferred to the device during the reaction transition and no reaction products are released from them, the process contained in it is called periodic. Management problems vary among both continuous and continuously running racers. The first is characterized by the issue of stabilizing the parameters of the given values in stationary mode, and for the second by observing the process using a specific program.

The principle of operation of the reactor. A nuclear reactor is an extremely complex and dangerous technical device. Its principle of operation is based on the fact that when one uranium atom decays, several neutrons are released, which, in turn, eject elementary particles from neighboring uranium atoms. As a result of this chain reaction, a large amount of energy is released in the form of heat and gamma rays. At the same time, if this reaction is not controlled in any way, that is, if the neutron flux is not kept stable, it is necessary to take into account that uncontrolled, unrestricted fission of uranium atoms can lead to undesirable consequences - a strong explosion.

Nuclear chain reactions are self-sustaining nuclear reactions in which the nuclear decay chain proceeds sequentially. This happens when one of the products of one nuclear reaction reacts with another nucleus, the product of the second reaction enters into a reaction with the next nucleus, etc. There is a chain of successive nuclear reactions. The most active example of such a reaction is the neutron-induced nuclear fission reaction. Fission products dissociate into two light nuclei (fission fragments) and neutrons (typically 2-3 neutrons) [6]. The resulting neutrons can cause the fission of other nuclei, which also create new neutrons capable of fission of another nucleus, etc.

3. Results and discussions

Thus, each cycle of a nuclear reaction creates conditions for the next cycle, and the stationary reaction can be self-sufficient. If the number of nuclei involved in the next cycle is greater than that of the previous cycle, then the number of nuclei involved in the reaction resembles an avalanche. The uncontrollable reaction is a nuclear explosion. If the number of neutrons participating in a chain reaction can be kept at the same level (for example: $k = 1.02$), then this is a controlled stable nuclear chain reaction (Figure 4).

Volume: 3 Issue: 9 | Sep–2024 ISSN: 2720-6874
http://journals.academiczone.net/index.php/ijfe

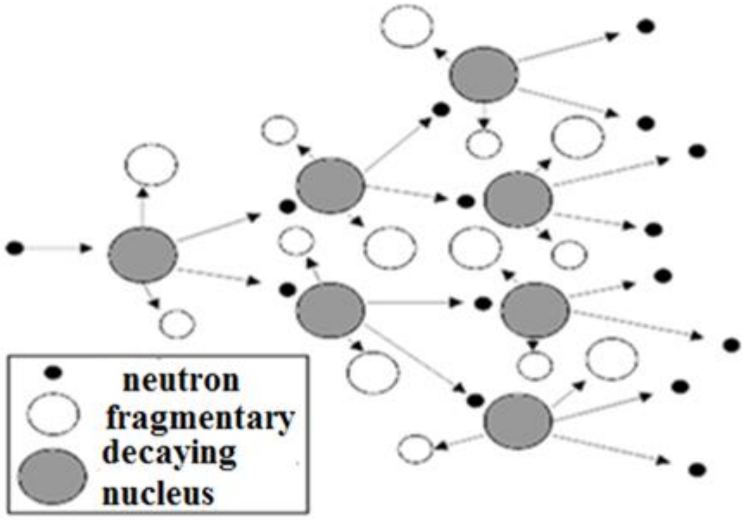

Figure 4. Schematic diagram of the chain reaction of nuclear fission.

There are four groups of nuclear reactors according to their application goals:

1. Nuclear reactors (energy source), which are used as sources of electricity and heat;

2. Nuclear reactors for the production of radiation sources of various types (also for research purposes);

3. Military-industrial reactors producing plutonium for weapons;

4. Nuclear reactors are synthesizers of new elements, including new radionuclides, isotopes.

Today, there are two main types of reactors that can be classified according to the spectrum of neurons:

A slow neutron reactor, also called a thermal reactor. For its operation, 235U uranium is used, for its enrichment, the production of uranium granules, etc. Today, most of the slow neutron reactors in the world are in operation.

Fast neutron reactor. The future belongs to those reactors that work with the isotope uranium 238U and do not need to enrich this element [7]. The disadvantages of such reactors are only that the design, construction and commissioning of such reactors cause enormous costs. Today, fast reactors are in operation only in Russia [8]. The coolant in fast reactors is mercury, gas, sodium or lead. The overall appearance of the reactor is shown in Figure 5.

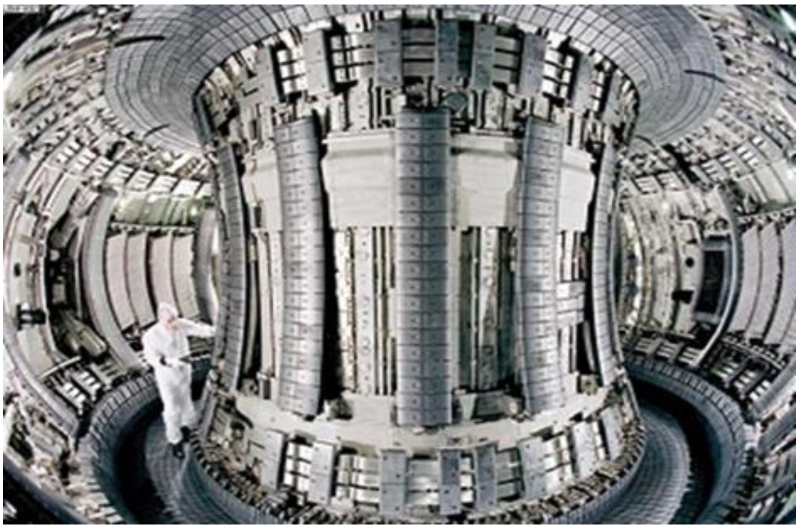

Figure 5. General view of the reactor.

Volume: 3 Issue: 9 | Sep–2024 ISSN: 2720-6874
http://journals.academiczone.net/index.php/ijfe

Slow neutron reactors, which are used in all Aes in the world, are also divided into several types. Since the principle of operation of AES largely depends on the choice of coolant and moderator, MAGATE has focused its classification on these differences: a1, a2, a3, a4, A5. These are the disadvantages and achievements of the AES, the general classifications are described in the following articles.

4. Conclusions

The use of integrated pedagogical technologies has created favorable conditions for intensifying the study of the descriptions of AES in pedagogical, pedagogical and psychological terms. Nuclear energy has taken a big step in recent decades and has become one of the most important sources of electricity for many countries. At the same time, it should be borne in mind that behind the development of this branch of the economy are the enormous efforts of thousands of scientists, engineers and ordinary workers who are trying to turn the "peaceful atom" into a real supplier of energy. The integrative presentation of the design, the principle of operation of nuclear reactors, the operational process and their practical significance allows students to gain comprehensive knowledge of AES s in a short time and acquire basic knowledge.

References

1. Мухин К.Н. Экспериментальная ядерная физика: Учебник. В 3-х тт. Т. 1. Физика атомного ядра. 7-е изд., стер. - СПб.: Изд-во «Лань», 2009. - 384 с.
2. Полат Е.С., Бухаркина М.Ю., Моисеева М.В., Петров А.Е. Новые педагогические и информасионные технологии в системе образования: Учебное пособие/ – М.: Издателский центр «Академия», 2009, с.269.
3. Ramazanov A.X., Polvonov C.R., Bozorov Ye.X., Narzulloyev A. Oliy ta’lim muassasalarida “yadro yenergetikasi” mavzusini o’qitishda interfaol usullardan foydalanish uslublari. O’zbekiston Milliy universiteti xabarlari, 2022, [3/2] ISSN 2181-7324. 487-489 betlar.
4. Лев Н.Р. Об изучении энергии связи атомных ядер // Физика в школе, 2001.- № 2. – С. 33-34.
5. Мастропас З.П., Синдеев Ю.Г. Физика: Методика и практика преподавания. – Р-н-Д: Феникс, 2002. с.11-32.
6. Тожиев М., Зиямухамедов Б., Ўралова М. ”Педагогик технология ва педагогик маҳорат фаннинг ўқув машғулотларини лойиҳалаш. Ўқув қўлланма”, Тафаккур-Бўстони, Тошкент-2012 .55-бет.
7. Ramazanov A. X. Tez neytron reaktorlari mavzusini nostandart testlar orqali o’qitish metodikasi. Vestnik KGU im. Berdax. № 4 (63), 2023, 146-150 bet.
8. Большов, Л. А. Стратегия развития ядерной энергетики России и вопросы экологии / Л. А. Большов, И.И. Линге // Атомная энергия. 2019. – № 127, вып. С.304–309.