REACTORS OF THE FOURTH GENERATION AND THEIR COMPARISON WITH THE REACTORS OF THE THIRD GENERATION

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Over the past few decades, the nuclear fission reaction has successfully proved the importance of its role as a source of energy. With that nuclear power will retain its role in the reduction of hydrocarbon resources.

Reactors of the third generation were first developed in the 1990s, but they are still widespread all over the world. As a rule, these are reactors with a light water coolant. Among them are Evolutionary pressurized reactors (EPRs) manufactured by AREVA, which are being built in Finland, France and China, AP-1000 manufactured by Toshiba-Westinghouse (advanced PWR) used in China, VVER-1200 a project "NPP-2006" developed by OKB "GIDROPRESS" in Russia, and APR(Advanced power reactor) -1400 produced by KEPCO in Abu Dhabi.

The weak side of existing nuclear technologies is their limited ability to use the energy potential of uranium fuel. Light water reactors of II and III generations are characterized by a low temperature of the coolant at the outlet from the core - about 300 ° C, which limits their thermal efficiency (about 30% for conventional light water reactors).

With the IV generation of nuclear technology, the term "reactor" is replaced by the term "system", which includes the reactor itself and the reprocessing of nuclear fuel. Such new systems should have higher performance compared to previous generations in development. They are safer, more reliable and possess protection from proliferation. Some produce electricity, and other generate heat at temperatures of 400-900 ° C and 100-300 ° C. High temperature can be used in various industrial applications like synthetic fuels, petrochemicals, biomass gasification, hydrogen production from water, glass or cement. Lower temperatures (100-300 ° C) can be applied to desalinate sea water and produce fertilizers.

Some IV generation systems will operate on fast spectrum neutrons. Their ability to reproduce fissile material in combination with advanced technologies of fission and transmutation offers great opportunities. Their nuclear fuel will be resistant to very high temperatures. As a result, their fuel cycle will be completely closed.

The main advantages of 4 Generation Reactors are as follows:

- they ensure optimal use of natural resources and reliability of energy supply
- minimal waste generation
- high thermal efficiency.

Such reactors are able to convert 238U into fissile 239Pu even more intensively than they themselves absorb fissile material. In addition, they can use fuel with very low uranium content.

These types of reactors are able to cope with the leaks of military nuclear technology. Closed reactors can be supplied to any countries, because they cannot receive raw materials for nuclear charges.

With the use of other heat carriers, higher temperatures can be reached 400-600 °C for CO2, 500-700 °C for liquid metals (sodium, lead) and 700-900 °C for helium. The temperature of the coolant at the exit from the core of 900 °C equals the thermal efficiency to 44%, that is approximately one third higher than that of classical light water reactors.

However, this type of reactors is also not perfect and one of the disadvantages is the need to organize reprocessing of fuel at nuclear power plants. Besides, higher costs when repairing can also be viewed as its drawback.

In 2002, the GIF Forum began organizing scientific cooperation among interested participating countries in the field of developing six new generation nuclear systems. Three systems were chosen that operate on fast-spectrum neutrons, one on thermal neutrons and two systems that can work in both the fast and thermal spectra.

Fast neutron reactor with a sodium coolant and a closed nuclear cycle (SFR) provides effective treatment of actinides and reproduction of fissile material (Japan, USA, France, Euratom, South Korea, China and Russia).

Fast neutron reactor with a lead or lead-bismuth liquid metal coolant and a closed nuclear cycle (LFR);

Fast neutron reactor with a helium coolant and a closed nuclear cycle (GFR)

High-temperature reactor with graphite retarder, helium coolant and open uranium fuel cycle (VHTR)

SCWR is a high-temperature reactor with a high-pressure water coolant operating above the thermodynamic critical point of water

MSR - generates energy due to the fission reaction in the epithermal spectrum, with the circulation of the coolant and fuel as a mixture of molten salts and complete burning of actinides

Conclusion

At present, scientific research and tests of various systems of the IV generation are being conducted all over the world. The ultimate goal is the implementation of the industrial system of the IV generation by 2040. Although, no one can predict when the industry and investors will be ready to start the construction of such innovative systems. The adoption of such decisions depends not only on the availability of scientific achievements and the required technological level, but also on the current economic and political situation.

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