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MODULAR LOW-POWER REACTORS AND POSSIBILITIES FOR THEIR IMPLEMENTATION IN UKRAINE

Ukraine plans to move from the construction of large units to small modular reactors.

Green energy continues to grow – these capacities are being introduced at a very high rate. The required capacities that compensate for them are maneuverability. Therefore, today we plan to refocus on the construction of small modular reactors that have the ability to maneuver [1].

SMR-160 technology can solve load management issues quickly and at the lowest cost, with significant increases in solar generation and unprecedented growth in wind energy that are rapidly replacing traditional energy sources. In addition, this type of generation does not lead to carbon emissions [1].

On June 10, 2019, NNEGC/ National Nuclear Energy Generating Company of Ukraine Energoatom, Holtec International and the State Nuclear and Radiation Safety Scientific and Technical Center of Ukraine signed a tripartite agreement. The signed tripartite agreement provides for the creation of an international consortium aimed at promoting SMR -160 Small Module Reactor (SMP) technology in Ukraine.

The main design decision, which determines the increased interest in the technology of modular reactors, is the ability to build high-power nuclear power plants from individual small reactors - modules that are built wall to wall. This makes it possible to significantly optimize capital costs during the construction phase of new nuclear power plants. And already at the expense of the first module, by investing funds from the generated electricity, it is possible to build other modules as needed. According to the Energy Strategy of Ukraine until 2035, a policy of extending the lifetime of operating units is envisaged. At the same time, due to the fact that 12 units of 15 units will be extended for the period from 2030 to 2040, the issue of construction of new capacity is becoming more urgent. Energoatom already plans to replace Rivne NPP Units 1 and 2 (type VVER-440) with six small SMR - 160 ″ reactors

Small modular reactors have a higher level of safety than traditional reactor types due to the lack of equipment that requires external power supply. For example, the design of the SMR-160 reactor, developed by Holtec International, involves the use of fewer valves, pumps, heat exchangers and other external equipment. This, in turn, leads to simplification of the operator's actions during the various modes of operation, including diagnosis and management in emergency situations. Moreover, spent fuel is stored inside the module after its expiration date.

SMR-160 main advantages:

– simplified design and compactness;

– inherently inherent security;
– increased physical protection;
– simplicity and reliability in operation;
– possibility of different use;
– short construction times and a competitive economy;
– arrangement of the reactor - underground using passive safety systems and low enriched uranium as fuel;
– due to the use of air cooling systems, the reactor can be built in regions with water shortages.

To accommodate a SMR-160 reactor, 4.5 acres of land (135 × 135 m^2) is sufficient, which allows the energy source to be brought closer to consumers, including the supply of specific areas and territories with complex geographical locations [2].

New technologies in the form of low-power modular reactors (SMPs) are currently being actively studied, developed and already under construction in the world. Currently, SMR developments are underway in many countries: Argentina, France, Canada, India, China, Japan, South Africa, the United Kingdom, the Russian Federation, the United States, Denmark, South Korea and others.

For comparison with high-power reactors, SMP suppliers claim a construction time of up to 36 months and an order of magnitude higher operating safety for these units.

We, as a Chernobyl survivor, cannot use technologies that have never been tested before to become a testing ground. Before making any decision, it is necessary to make sure it is safe. Taking into account the importance of mentioned above facts the State Nuclear and Radiation Safety Center of Ukraine suggests an approach aiming at overcoming regulatory and design differences between US and Ukrainian technologies and signing a memorandum of understanding with NuScale. This document makes it possible support the implementation of NuScale SMR modular nuclear reactors in Ukraine.

The NuScale reactor has a capacity of 60 MW, for example, one RVP unit VVER-1000 has an electrical capacity of 1000 MW.

NuScale reactor size is like two buses and it is designed with modularity in mind. If there is a need to increase the power, several settings can be installed. NuScale's main body of work is plain water – the most popular type of body in nuclear power.

The small size of NuScale ensures its safety. To protect it from radiation, it is placed in an underground pool. If radiation leaks, it will remain in this pool. The calculations show that this reactor can withstand almost any critical situation without melting.

The first power plant from 12 NuScale reactors is set to start electricity generation in 2026 in the United States [3].

Small-scale reactors that have a near-term implementation potential (up to 10 - 15 years) are of the following types of housing reactors: PWR (water-pressure water), fast-neutron reactors or high-temperature (preferably gas cooled) reactors.

Our participation in the Small Module Reactor Club allows us to keep our hands on the pulse of the latest nuclear technology in nuclear power. And, as we know, perhaps from 2022 we will become one of the first countries to adopt such technologies, and perhaps even become an energy start from where these technologies will be distributed worldwide.

REFERENCES

1. «Енергоатом» планує перейти на новий тип реакторів: веб-сайт. UR L: https://thepage.ua/ua/news/energoatom-planuye-perejti-na-novij-tip-reaktoriv.

2. Власенко М. І., Про перспективи спорудження модульних реакторів : веб-сайт. URL: http://www.energoatom.com.ua/uploads/05_vlasenko.pdf.

3. Модульний атомний реактор NuScale: веб-сайт. URL: https://sstc.ua/ news/dano-start-procesu-vivchennya-mozhlivostej-licenzuvannya-smr-v-ukrayini.