INSTITUTIONAL SUPPORT TO THE NUCLEAR POWER BASED ON TRANSPORTABLE INSTALLATIONS

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Abstract Existing nuclear power uses large-power nuclear plants (more than 1,000 MWe) and enriched uranium fuel ($^{235}$U). Each plant is treated as an exclusive costly project. As a result, large NPPs are operated predominantly in highly developed big countries. In many countries, construction of large power units is not reasonable because of the economic conditions and national specifics. This calls for the use of small- and medium-power nuclear plants (SMPNP), especially transportable nuclear installations (TNI). TNI feature small power (up to 100 MWe); serial production, and transportability. Small- and medium-power nuclear plants could serve to produce electricity and heat; perform water desalination; provide temporary and emergency energy supply. The authors discuss some findings of the studies carried out on the various aspects of the TNI life, as well as the legal and institutional support to their development, construction and operation. The studies have been performed in the framework of the INPRO Action Plan.

Keywords: nuclear power, innovative nuclear energy system, reactor design, small power plants, GNEP, INPRO, non-proliferation of nuclear weapons, safety, waste, transportable nuclear facilities, institutional support to the nuclear power, NPP life

Introduction

The world’s nuclear power has been developing in the last 50 years based on large-power plants (more than 1,000 MWe) using enriched uranium fuel ($^{235}$U). Today, there are more than 400 nuclear units in operation across the world. Each plant is treated as an exclusive and very costly project. Because of this, large NPPs are used predominantly in big countries with well-developed technologies. Thus, in France nuclear accounts for 77% of the electricity generation, in Japan – for 28%, in the USA – for 20%.

At present, BRIC countries (Brazil, Russia, India, China) have clearly defined plans for a large deployment of nuclear sources in the twenty-first century. Many developing nations have been showing great interest in the services provided by
the nuclear power. More than 50 countries have stated their intention to join the civil nuclear club. However, the economic conditions and specifics of many countries make construction of large power units there unreasonable. Together with the level of their economic development, this suggests application of small- and medium-power plants (SMPNP), especially transportable nuclear installations (TNI).

TNI may come as large-block plants with pre-fabricated components delivered to the operation site and assembled there, or as mobile facilities operated directly on transport platforms (wheel-, crawler- or track-mounted, or floating) in a point-to-point position. The terms “transportable” and “mobile” are taken from the terminology of the 1950s–1970s, when the facilities of this kind were constructed and operated in Russia and in the United States.

The specific features of transportable nuclear installations include small power (up to 100 MWe); serial production; transportability.

At present, there exist objective trends pointing to a growing interest in the plants with small and medium power (SMPNP):

- Nuclear vendors have suggested more than 50 designs of small (up to 150 MWe) and medium (up to 700 MWe) facilities.
- The international programme “Global Nuclear Energy Partnership” (GNEP) has declared the intention to supply small- and medium-power plants in the framework of international cooperation.
- Russia has started construction of the world’s first 70 MWe floating nuclear plant “Michail Lomonosov” with ice-breaker reactors.

Small- and medium-power nuclear plants could:

- Produce electricity, heat and fresh (desalinated) water for local markets
- Deliver emergency energy supply granted to a country or a region by the world community (UN) in certain circumstances and on certain conditions
- Provide temporary energy supply (within a limited period of time) for power-consuming industrial projects and activities

On the other hand, there is considerable expertise in the construction and operation of small nuclear facilities, since some countries have been building and running naval and marine nuclear power installations in parallel with the construction of large nuclear units. Hundreds of small facilities were built primarily in the USA and Russia. An important distinction of the shipboard nuclear facilities is serial production. In addition, Russia has been successfully operating for a long time the world’s sole small-power nuclear plant – Bilibino at Chukotka. Taken together, this experience and the advancement of reactor technologies could make a good foundation for supplying serial small- and medium-power nuclear plants to various users.

The authors present some findings of the studies on the various aspects of the TNI life, as well as the legal and institutional support to their development, construction and operation. The studies have been performed by a team of Russian