ROSATOM NEWSLETTER

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Blades Set Spinning

The first wind turbine was installed in mid-January at the Novolakskaya Wind Farm, which is being built by Rosatom's wind power division, Rosatom Renewable Energy. It is 150 meters high and has 50 meters long blades. The wind farm is yet another move made by Rosatom to boost wind power generation in Russia. The Russian corporation also intends to build wind farms abroad, with in-house manufactured components, generators and blades, to be used in the construction.

The Novolakskaya Wind Farm is planned to have 120 wind turbines with a total capacity of 300 MW. The construction project will be divided in two stages, with 61 wind turbines to be installed in 2025 and another 59 in 2026. The wind farm is expected to generate 879 million kWh of electricity on the annual average. "I am confident that the Novolakskaya Wind Farm will make a large contribution to the efficient operation of the regional energy sector, securing economic stability and well-being of Dagestan residents," said Grigory Nazarov, CEO of Rosatom Renewable Energy.

Taking into account the wind capacity commissioned to date, the wind power division of the Russian nuclear corporation will build 1.7 GW of new capacity by 2027.

1.7 GW

of wind capacity will be operated by Rosatom by 2027

Rosatom is also working on international wind power projects. Its program provides for up to 5 GW of renewable energy projects to be contracted by 2030. The key destinations for the program are CIS countries, Turkey, and others.

In March 2024, Rosatom and Kyrgyzstan signed an agreement at Atomexpo to build a total of up to 1 GW of wind capacity in the country. A 100 MW wind farm in the Issyk-Kul region of Kyrgyzstan is Rosatom's first wind power project abroad. In September 2024, a memory capsule was laid at the planned wind farm site; in December, Rosatom Renewable Energy and the Government of the Kyrgyz Republic signed a project investment agreement. Site surveying and equipment ordering are scheduled to start in the second half of 2025.

Afterwards, the parties plan to assess other sites for the deployment of up to 900 MW of renewable capacity.

Self-reliance

It is important to mention that Rosatom builds wind farms with the components that are manufactured at the Rosatom Renewable Energy plant in Volgodonsk, Russia. Until recently, these included nacelles, hubs, generators, and tower base platforms only. Last December, the product range was added with blades, a key component of the wind turbine. Blades used to be imported, but now they are manufactured at a production site in Ulyanovsk, Russia, which is part of Rosatom's composite division. These blades will be installed on the wind turbines of the Novolakskaya Wind Farm, and also be available to foreign customers.

"We have a number of international contracts, primarily in Kyrgyzstan, a member state of the Eurasian Economic Union, where our partners are looking for wind power technology to become technologically sovereign in this field. We will be glad to ship blades for their wind farms. A number of other countries are contemplating to build not only nuclear power plants but also 'green' energy clusters that will include wind and solar generation facilities," said Rosatom Director General Alexey Likhachev at the opening ceremony for the Ulyanovsk plant.

Wind turbine blades are manufactured as follows. First, fiberglass fabrics are cut into pieces on a cutting table, with pieces then twisted into rolls. Spar caps are produced in parallel. A spar cap is a laminated strip running along the entire length of the blade half and consisting of several layers of carbon fiber fabric.

Then the blade halves are formed: fiberglass fabric, spar caps, and fastening elements for securing the blade to the generator hub (nacelle) are placed into the mold, followed by meshes, tubes and other parts. The mold is covered with film, vacuumed and filled with resin; then the halves are left to cure. Spars and lightning protection systems are installed onto the spar caps of the finished blade halves, which are then fitted together and glued. The seam quality is checked with a flaw detector and a thermographic camera. After the blade is assembled, blade mounting bushings are milled, glue seams laminated, and geometric parameters checked. The blades are then coated with putty, painted, weighed, balanced and sent to the finished product warehouse.

The design of the blade was commissioned by the wind power division back in 2016. The 51 meters long blade weighs 8.5 tons and is 90% glass composite and 10% carbon composite. The blades of this design are installed on 2.5 MW turbines produced by Rosatom Renewable Energy. Fiberglass and carbon fiber fabrics used in the blades are manufactured at a plant of Rosatom's composite division. The plant is capable of producing 450 blades per year. The blades have been tested to international standards at a certification center.

Photo by: Rosatom Renewable Energy/ Newspaper Strana Rosatom

MCP: Fuel Transformations

Employees of the Mining and Chemical Plant (MCP) know well how to handle spent nuclear fuel to make it fresh again. This February, MCP is celebrating its 75th anniversary. This one-off plant, some of whose production facilities are located deep in the rocks above the Yenisei River, plays an important role in the development of a closed nuclear fuel cycle and the back-end management of spent nuclear fuel in Russia.

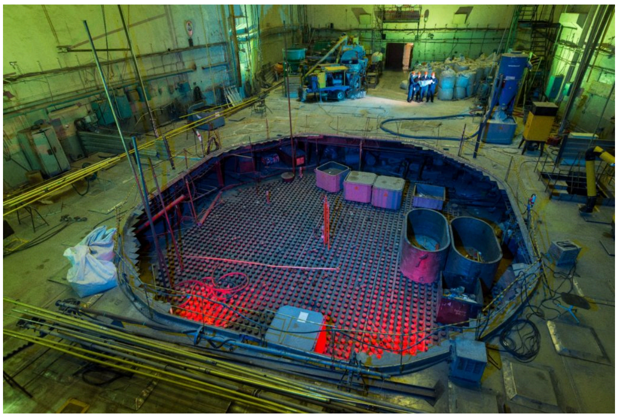
Where it all began

MCP traces its history back to February 26, 1950 when the USSR Council of Ministers adopted a resolution on the construction of an underground nuclear production site (Combine No. 815) in the Krasnoyarsk Krai. It became later known as the Mining and Chemical Plant.

The plant used to operate three successively constructed uranium-graphite reactors code-named AD (1958), ADE-1 (1961), and ADE-2 (1964). The plant also has a radiochemical facility for the reprocessing of spent nuclear fuel and extraction of weapons-grade plutonium. It was decided to place the reactors deep in rock shafts to protect them against a possible attack.

AD and ADE-1 were single-purpose reactors used for plutonium production only. ADE-2 was the world's first dual-purpose reactor, which also generated electricity. It was connected to an underground thermal power plant that used to supply heat to the nearby town of Zheleznogorsk for almost half a century. ADE-2 was shut down for decommissioning as late as 2010.

The first two reactors were shut down back in 1992. In 2023, they were decommissioned with an 'in-situ disposal' option (the reactor and some adjacent premises were filled in with barrier material). This drew down the curtain over the production and extraction of weapons-grade plutonium, the primary task performed by MCP in the 20th century.



Modern days

MCP's current mission is to develop an end-to-end technology for managing irradiated fuel from power reactors and closing the nuclear fuel cycle.

Its key goal for this year is to commission the second fuel reprocessing facility for a pilot spent fuel management center. The first facility built in 2015 is a chain of hot cells and an analytical laboratory that studies spent fuel reprocessing and waste management techniques.

"With the second facility in place, we will be able to reprocess spent nuclear fuel on a commercial scale. The new technology will make it possible in the future to stop accumulating and minimize burying radioactive waste, and bring us closer to the deployment of Generation IV energy technologies," says Vasily Tinin, Director for Radioactive Waste, Spent Nuclear Fuel and Nuclear Decommissioning Policy at Rosatom.

In the next few years, the spent fuel management center will become a globally unparalleled test site for spent fuel management technologies. The test results obtained will be used for the purpose of designing large-scale radiochemical production facilities.

Another area of focus is the production of uranium and plutonium mixed oxide (MOX) fuel for the BN-800 fast neutron reactor installed at the Beloyarsk NPP. This fuel makes it possible to use plutonium as a feedstock material for the fabrication of fresh fuel, which can be later recycled. The MOX fuel production facilities were built in 2011–2014. The manufacturing line is automated and placed in a chain of radiation protection enclosures and chambers. It ensures regular deliveries of MOX fuel assemblies for the refueling of the BN-800 reactor. Our readers should remember that BN-800 has been operating with a 100% MOX fuel core since 2022.

MCP is also working on a project that is of great importance for the environment. The project provides for the development of Russia's first molten salt research reactor (MSRR). It is needed for the transmutation ('burning') of minor actinides, highly radioactive long-living transuranium elements that are formed during fuel irradiation. This would dramatically reduce the volume of waste and its half-life. R&D on the molten-salt reactor has been underway since 2020. Its concept design is ready, and researchers are studying the composition of salts, which will combine the functions of fuel and coolant, and testing structural materials for the reactor and its systems.

Another task related to the MSRR development is the decommissioning of the ADE-2 reactor and the underground cogeneration plant as the plant's site is being prepared for the construction of the new reactor. In turn, the ADE-2 reactor room will be converted into a nuclear industry museum after the work is completed.

Photo by: MCP, Rosatom State Corporation, (Rosatom)

News from Kudankulam

In January, a reactor pressure vessel for Unit 6 arrived at the nuclear construction site near India's Kudankulam. This is where India is building four Russian-designed power units with input from Rosatom, and another two units have long been in operation. Each of these six units has a VVER-1000 reactor. Here is our update on India's largest nuclear construction project.

The 320-tonne VVER-1000 reactor pressure vessel (RPV) for the sixth unit of the Kudankulam Nuclear Power Plant was manufactured at Atommash (part of Rosatom's mechanical engineering division). The RPV was transported from Volgodonsk, where the production site is located, on a special vehicle to the plant's pier to be loaded onto a river vessel and shipped to the sea port of Novorossiysk. Then it was placed in the hold of a sea-going ship and traveled a distance of 11,000 kilometers to the construction site.

The Kudankulam NPP project is divided into three phases, each with two units. Rosatom's engineering division and the Nuclear Power Corporation of India Limited (NPCIL) is currently building four power units. Two power units of the first phase are already in operation.

Construction works are nearing completion at Unit 3. Workers are laying pipelines for the safety and auxiliary systems in the reactor building. Control cabinets for the regular and backup I&C systems are being installed. Turbine cylinder housings are being assembled in the turbine building. Preparations are underway for the first pre-commissioning works. The plan for this year is to energize auxiliary power lines, launch a desalination plant, and flood the water intake area. The flooding will be done through a controlled demolition of the temporary dam. All these steps are necessary to prepare the reactor for flushing operations, which are also planned for the current year.

Meanwhile, construction works are continuing at pace in the auxiliary reactor building and the turbine hall, and the outer containment shell is being erected at Unit 4. The reactor equipment is already in its design position, while the transportation airlock is being assembled. Welding on the primary coolant piping is scheduled to begin in the reactor building in the second quarter of this year.

Besides, Rosatom's fuel division is working to deliver on the contract for the supply of nuclear fuel for Units 3 and 4 with VVER-1000 reactors, which will have 18-month refueling intervals starting from the first fuel loading. The power units of the project's first phase used to have a 12-month refueling interval but, with the introduction of an advanced fuel design in 2022, were converted to an 18-month interval.

Construction of a reactor building, an auxiliary reactor building and a turbine hall is underway at Unit 5. It is planned for the current year to finish concreting the inner containment structures up to the bottom floor level of the reactor building's central hall, and install the reactor pressure vessel in the design position.

Reactor and turbine buildings and an auxiliary reactor building are also under construction at Unit 6. The plan for 2025 is to install the reactor pit equipment, including the molten core catcher, cantilever truss, and dry shield. A set of four steam generators for Unit 6 will also be shipped in the same year.

Reliable energy for South India

The first-phase reactor units reached an important milestone in 2024 as their power output exceeded

100 billion kWh in July. The two operating units provide electricity for about 50 million households in the Indian states of Kerala and Tamil Nadu.

As a reminder, Unit 1 was connected to the grid in October 2013, followed by Unit 2 in August 2016.

>100 B kWh

is a cumulative power output at the first two units of the Kudankulam NPP

“The Kudankulam NPP owes its efficient operation to the proven design solutions, reliable equipment, and high-quality construction, installation and commissioning works. Every step, from engineering to commissioning, is made in close, comprehensive cooperation between the Indian project owner and the Russian contractor. Each party puts in its unique competencies to build a technologically sophisticated and efficient facility that meets the highest requirements for both quality and safety,” says Alexey Zhukov, First Vice President for Construction at AtomStroyExport.

The Kudankulam NPP is India’s largest power plant in terms of both individual unit capacity and total installed capacity. Russian engineers developed a series of technological solutions specially for this plant, including a system of hydraulic structures for environmental protection and uninterrupted supply of cooling water from the sea.

The cooperation between Rosatom and India continues. For example, Rosatom Director General Alexey Likhachev met Indian Prime Minister Narendra Modi during his visit to Russia in 2024 and suggested joining forces for the development and local production of small modular reactors.

Photo by: Rosatom Mechanical Engineering Division, Rosatom Engineering Division

Stepping into New Era

The International Energy Agency (IEA) has released an analytical report entitled The Path to a New Era for Nuclear Energy. Unfortunately, the report is not free from bias and distortion as its authors tried their best not to mention Russia's activities in building new nuclear capacity, including small-scale generation. For this reason, we will supplement the report with information about the Russian nuclear industry.

State of affairs

The report admits, though, that Russia and China are the most active players of the nuclear power market. It is them who give an impetus to the development of the nuclear industry. Out of 52 reactors established worldwide since 2017, 25 are of Chinese design and 23 are of Russian design. The countries that are traditionally called 'developed economies' account for most of the global nuclear reactor fleet, but China is expected to overtake both the United States and the European Union in terms of total installed capacity by 2030.

"Rejuvenating this fleet has not been easy: the nuclear industry in long-time market leaders, such as the United States and France, has struggled in recent years with project delays and cost overruns for all new large-scale reactors," says the report. This statement is reflective of the biggest controversy of the report: the authors try to give the US the semblance of a leader, while maintaining accuracy in describing the facts showing that Russia and China are in the lead. The authors see this situation as a risk, but it is actually a great opportunity for those who would prefer working with Rosatom, a company that is continuously improving its technology and solutions.

23 out of 52

reactors under construction worldwide are of Russian design

"We keep going forward despite our confident position in the nuclear world. We are evolving to make our products and solutions more perfect in terms of engineering, unparalleled safety, and cost effectiveness. We are currently developing a power reactor unit that will be more powerful and have improved operating and economic performance, to be built both in Russia and other countries," said Valery Kryzhanovsky, Chief Designer at OKB Gidropress, commenting on the shipment of a VVER-1000 reactor to India's Kudankulam NPP.

New additions, large and small

The authors of the report are confident that nuclear generation will continue to grow in each of the three scenarios they proposed. The first of them, the Stated Policies Scenario (STEPS), assumes that current policies are maintained; another one, the Announced Pledges Scenario (APS), assumes that countries and organizations meet their commitments; the third scenario, Net Zero Emissions (NZE), shows a pathway for the energy sector to achieve net zero emissions by 2050. “The global nuclear fleet expands in each of the three scenarios. Capacity rises by around half from 416 gigawatts (GW) at the end of 2023 to 650 GW by 2050 in the STEPS, more than doubles to 870 GW in the APS, and exceeds 1,000 GW in the NZE Scenario (Figure 2.3). Lifetime extensions play an important role in each case. For example, they account for around 150 GW, or 20% of global capacity, in 2040 in the APS,” says the report.

The report’s summary focuses mainly on small modular reactors (SMRs): “Cost-competitive SMRs, boosted by government support and new business models, can help clear the path to a new era for nuclear energy.” However, the body of the report notes that SMRs will not dominate the nuclear power industry of the future although the interest in them persists: “Large-scale reactors make up most new nuclear capacity in all scenarios; in the APS, over 500 GW of them are built from 2024 to 2050.”

It should be noted that Rosatom plans to build 38 large, medium and small-scale power reactors in Russia by 2042, with some of them being the first of their kind. Their total installed capacity will be 29.3 GW. Of these, there will be eight 1,200 MW reactors, seven 1,255 MW reactors, two 1,000 MW reactors, and five 600 MW reactors.

SMRs will be built as well. For example, it is planned to put in operation the world’s first nuclear power plant with a lead-cooled fast neutron reactor BREST-OD-300. Rosatom is also working on the construction of floating power units with RITM-200 reactors to supply power to the Baimsky GOK mining site, making on-site preparations to pour concrete for the foundation of the Yakutian SMR nuclear power plant with an onshore modification of the RITM-200 reactor, and implementing projects to develop small-scale nuclear power plants with RITM-400 and SHELF reactors.

38 reactors

with a total capacity of 29.3 GW will be built in Russia by 2042

In addition, Rosatom was the first ever company to conclude an export contract for the construction of an SMR nuclear power plant. Six power units with RITM-200 reactors will be built in the Jizzak Region of Uzbekistan. Finally, the world’s only floating nuclear power plant Akademik Lomonosov supplies power and heat to the town of Pevek in Chukotka. All these facts demonstrate that it is Rosatom that holds the leading position in the small modular reactor segment globally.

Investment rise and fall

In the three years from 2020, annual investment in nuclear energy, both in new capacity and life extensions, increased by nearly 50% to more than USD 60 billion. Investment in nuclear generation and installed capacity is expected to increase globally in each of the three scenarios, the report says.

The STEPS assumes quite a modest growth, from about USD 65 billion in 2023 to around USD 70 billion in 2030. New large-scale reactors will account for nearly 80 percent of investment in 2030, while SMRs will account for as little as 10 percent. The remaining 10 percent will be invested in life extension and capacity expansion projects. However, annual investment in nuclear energy will decline after 2030, especially after 2040, amounting to only USD 45 billion in 2050. The report attributes the decline to a downturn in the construction of new reactors in China and a decrease in investment in both large-scale reactors and SMRs.

The APS sees investment in nuclear power to nearly double worldwide and stand around USD 120 billion in 2030, including about USD 25 billion to be invested in small-scale nuclear generation. Afterwards, investment in both large-scale and low-capacity plants will decline sharply down to USD 60 billion in 2050. SMRs will account for over a third of total investment in nuclear generation after 2040. As seen by the IEA experts, the decline will be driven by the fact that national energy systems will approach or reach full decarbonization by 2050. As a consequence, new low-emission capacity will require less investment.

In the NZE scenario, investment is estimated to reach USD 155 billion in 2030 and then decline to about USD 70 billion by 2050. The authors of the report also attribute these figures to accelerated decarbonization processes across national energy systems by 2040.

In each of the scenarios, stronger-than-forecast growth in electricity demand could improve prospects for a more consistent investment in nuclear energy over the long term.

According to the IEA, cumulative investment in nuclear generation between 2024 and 2050 could reach USD 1.7 trillion in the STEPS, USD 2.5 trillion in the APS, and around USD 2.9 trillion in the NZE scenario.

The forthcoming increase in money flowing into the global nuclear industry seems to be encouraging but for one thing. If we compare the IEA estimates with investment in other energy segments, it becomes obvious that, unfortunately, investor interest in nuclear energy remains extremely low. For example, British Petroleum's Energy Outlook published in July 2024 says that investment in low-carbon energy sources has grown very rapidly in recent years. It has increased by nearly 50% since 2019, reaching about USD 1.9 trillion in 2023. A simple comparison of the available figures shows that the contribution of nuclear generation to the total investment in low-carbon energy sources was about 3.4% in 2023, and the estimated investment in nuclear over 27 years in the STEPS is lower than the investment in low-carbon generation in 2023 alone.

> $60 B

is invested every year in nuclear energy globally

Recommendations in action

IEA experts point out that the long-established financing models, such as public-private partnerships or project financing, are not well suited for financing the construction of new capacity due to the risks associated with long service lives, high costs, cost overruns, and long-lead times before any investment starts to pay back. Therefore, nuclear projects need continuous government support. This is especially true for the first-of-a-kind projects.

The risk of cost overruns in such projects cannot be mitigated without well-developed production capabilities, strong and flexible supply chains, streamlined project delivery processes, standardized equipment production, and qualified personnel.

This is what applies to Rosatom in full. The Russian nuclear corporation has in-house production facilities capable of manufacturing the necessary equipment, powerful computers and software systems enabling complex calculations needed for the design and construction of nuclear reactors, assemblies, components, fuel, core simulation, and much more.

Rosatom develops new designs, which are first implemented in Russia, commercializes them, and then offers new products to the customers all over the world. VVER-1200 may serve as an example from the large-scale reactor segment. Power units with these reactors have been built at Russia's Leningrad and Novovoronezh nuclear power plants, and also in Belarus. The same-design units are being built in Russia, China, Turkey, Egypt, and Bangladesh. In the near future, construction of VVER-1200 reactors will begin in Hungary. Examples from the small modular reactor segment comprise RITM-200, a reactor that has been powering Project 22220 icebreakers for several years and is now installed at offshore and onshore low-capacity power plants. The next step will be the deployment of Generation IV energy systems that will use thermal neutron and fast neutron reactors to close the nuclear fuel cycle. "In the next decade, we will start using this technology to build large-scale power units in our country and offering it to international customers," said Rosatom Director General Alexey Likhachev, speaking at the

Knowledge. State forum in late January.

Rosatom keeps improving and upgrading its technology, solutions and materials for power units and nuclear fuel by introducing, for example, additive technologies and composite materials. The production culture is being improved, and improvements, often developed by Rosatom employees, are introduced into the production and business processes. Finally, extensive work is going on to train qualified professionals for the industry, and it often begins as early as at schools and sometimes kindergartens.

Thus, Rosatom has many years been putting into practice what IEA experts only present to their target audience.

Photo by: Leningrad NPP, Kursk NPP, Floating NPP, Petrozavodskmash