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Empowering Better Future

In August 2025, Russia's nuclear industry is celebrating its 80th anniversary. It was August 20, 1945 when a decree was signed establishing a Special Committee under the USSR State Defense Committee, tasked with overseeing all efforts to harness the energy of uranium fission. This date marks the beginning of the Soviet atomic project. Today's generation of Russian nuclear professionals continues the legacy of their great predecessors, unlocking new possibilities in nuclear technology.

The nation's top mathematicians, physicists, chemists, and engineers pioneered nuclear power, an entirely new form of energy. In the late 1940s, physicist Igor Kurchatov, who led the atomic project, proposed building the world's first power plant fueled by uranium fission. On June 26, 1954, the Obninsk Nuclear Power Plant, the world's first operational nuclear power station, fed electricity into the grid. That same year, the USSR Council of Ministers approved a large-scale program to build nuclear power plants across the Soviet Union.

The Obninsk NPP also paved the way for the advancement of nuclear energy in other countries. Today, 416 nuclear power units with a combined capacity exceeding 376 GW are operating worldwide. In Russia, 36 power reactors with a total capacity of 26.8 GW generate reliable, clean nuclear power.

Russian nuclear experts continuously refine nuclear energy technologies, offering increasingly innovative solutions to international partners. For instance, various modifications of VVER reactors have become the most sought-after design in the global market for large nuclear power plants. Rosatom's portfolio includes international orders for 33 high-power VVER reactor units across 10 countries.

Rosatom is also a leader in small modular reactor (SMR) technology. Russian nuclear engineers were the first — and so far, the only — to build a floating nuclear power plant, the Akademik Lomonosov. Four more floating power units with RITM-200 reactors are currently under construction to supply electricity to the Baimsky GOK mining site in Chukotka. The Russian nuclear corporation is discussing different floating power plant projects with international partners, while preparing to build a land-based SMR in Yakutia (Russia) and advancing the world's first export project for a six-unit SMR plant in Uzbekistan.

Rosatom has proposed a concept for Generation IV reactor systems. The concept promises significant improvements in safety and efficiency while closing the nuclear fuel cycle by reprocessing spent fuel and reusing depleted uranium left over from enrichment. This approach maximizes the use of energy contained in natural uranium, reducing both the need for new mining and the volume of radioactive waste.

These principles are being implemented as part of the Proryv (Breakthrough) project: Russia is constructing an unparalleled lead-cooled fast-neutron reactor BREST-OD-300, along with fuel reprocessing and refabrication modules at the same site. Fast-neutron reactors represent a primary focus for Russian nuclear industry. The first such reactor, BR-2, was launched in 1956, and since then multiple research and power reactors of this type have been built, some of which remain operational today. Rosatom is also constructing a powerful research reactor MBIR, which has attracted strong interest from the global nuclear community.

New leadership

Russian nuclear industry has always been multifaceted, advancing new materials, computing systems, nuclear medicine, and much more. Leveraging this expertise, Rosatom has cultivated entire industries where it now holds leading positions.

TVEL, Rosatom's fuel division, is expanding into additive manufacturing, producing powders and 3D printers and playing a key role in introducing additive technologies in Russia and abroad. Rosatom is also building production facilities for lithium-ion batteries, supporting the development of materials for such batteries and participating in the creation of domestic electric vehicles. Three Rosatom divisions are involved in deploying electric charging infrastructure across Russia. The mining division is developing projects to produce lithium carbonates, lithium hydroxides, and concentrates of certain rare-earth metals used in manufacturing magnets and, by extension, electric motors. Setting up production of magnets at one of Rosatom's factories is also in the plan. The composite materials division has established vertical supply chains, from raw materials to glass and carbon fiber composite components and products. The wind energy division is constructing and operating wind farms in Russia and exploring similar projects abroad.

Rosatom is unlocking the logistics potential of the Northern Sea Route (NSR). Thanks to the world's only nuclear-powered icebreaker fleet, freight traffic on the route grows every year, and the NSR is becoming an increasingly prominent and vital artery in global logistics.

Rosatom is advancing nuclear medicine. The Russian nuclear corporation holds leading positions in the production of medical isotopes, developing radiopharmaceuticals and promoting their use in diagnostics and treatment. Rosatom also shares its expertise internationally. In Bolivia, for example, it is building a cutting-edge nuclear research and technology center with a cyclotron, a multipurpose irradiation center, radiobiology and radioecology laboratories, and a research reactor.

Rosatom is making the planet cleaner by addressing accumulated environmental damage—remediating municipal landfills, hazardous chemical facilities, and nuclear and radiation-contaminated sites.

Cutting-edge technologies

From its inception to the present day, Russian nuclear industry has remained at the forefront of scientific and engineering innovation. Rosatom is contributing to the development and application of fusion and quantum technologies, supercomputers, artificial intelligence, biofabrication of tissues and organs, and Russian space programs. Russian nuclear experts are shaping the future technological landscape both in Russia and worldwide. Their work will benefit humanity for decades to come, on Earth and beyond.

Photo by: Rosatom, Leningrad NPP, Atomflot

Education Drives Nuclear Energy

Rosatom trains professionals from around the world, and many of them will work in the nuclear sector. From 2019 to 2024, over 1,900 people from more than 60 countries completed training under international programs alone. These programs are run by Rosatom's Technical Academy (Rosatom Tech) in collaboration with the IAEA, but Rosatom Tech organizes its own courses, too. Maria Khaletskaya, Vice Rector of Rosatom Tech, shares more details.

— Could you please tell us about Rosatom Tech's collaboration with the IAEA?

— We have been actively working with the IAEA since 2011 when we started hosting training sessions focused on nuclear infrastructure. In 2018, Rosatom Tech, the IAEA, and Rosatom's Emergency Response Center signed a cooperation agreement to strengthen competencies in nuclear safety, radiation protection, and emergency response. As part of that agreement, we launched a joint Competency Development Center.

In 2019, we became the first and still the only IAEA Collaborating Centre that offers training to global nuclear professionals across three areas: nuclear energy, nuclear security, and non-power applications of nuclear energy. In October 2024, Rosatom Tech had its status as a Collaborating Centre extended, while expanding partnership with the IAEA.

Every year, Rosatom Tech and the IAEA organize Schools of Nuclear Energy Management and Nuclear Knowledge Management. We also provide training as part of INT2024, an IAEA project focused on nuclear infrastructure development, and INT2023, which supports the advancement of small modular reactor (SMR) technologies.

— Where do the participants come from?

— From all over the world, especially from Asia, Africa, and the Middle East. Participants from Cuba and Kuwait joined us for the first time in 2024, followed by Myanmar in 2025. This country is planning to build four Russian-designed small modular reactors. The largest groups typically come from the countries where Rosatom is constructing large nuclear power plants. These are Egypt, Turkey, Bangladesh, and Belarus.

— What kinds of training programs are offered?

— Our programs fall into four main categories. First, we organize schools that give attendees a broad overview of the nuclear industry, including governance models, infrastructure, and human resource development. These are best suited for young professionals and early- to mid-career managers who want to build a strategic perspective of the nuclear sector.

The second category includes more focused courses that address practical topics and reinforce essential knowledge, though they do not go too deep into the technical side. These courses are accessible to a wide range of attendees from different backgrounds.

The third category comprises practice-oriented workshops for seasoned professionals who are looking to dive deeper into a specific subject area. These programs often feature real-world case studies and encourage the exchange of hands-on experience among peers.

And finally, there are scientific visits, which are designed for advanced audiences and customized to meet the particular needs of the participating countries.

What makes all our programs stand out is the inclusion of technical site tours to nuclear facilities relevant to the program topic.

— What courses are happening this year?

— This year, we are offering a diverse mix of training programs that cover everything from site selection for nuclear facilities and feasibility studies for small modular reactors to knowledge management, stakeholder relations, closed nuclear fuel cycle, radioactive waste management, strategic decision-making, and digital solutions for Generation IV reactor technologies.

As an example, this May we hosted a course dedicated to the site selection process for nuclear power plants, including SMRs. The course brought together more than 20 attendees from 18 different countries, among them Armenia, Brazil, Kazakhstan, Sri Lanka, and Zambia. IAEA experts spoke about the support for the construction of nuclear power plants and shared experience from the Member States, while attendees shared insights from their domestic nuclear programs, highlighting the obstacles they faced and how they addressed them. As part of the course, they also visited the Kalinin Nuclear Power Plant.

— Are the courses held in person?

— Mostly, yes. But when needed, we do offer remote or hybrid formats via videoconference.

— How can someone apply?

— Only through InTouch+, the IAEA's official platform. Rosatom Tech and the IAEA coordinate everything: topics, dates, formats, curricula, and instructors, ensuring the courses deliver real-world expertise.

— Do the courses end with an exam?

— Our joint programs with the IAEA do not have final exams. Participants receive a certificate of completion after the course.
— Rosatom Tech also runs its own training programs. What are those about?

— Our Nuclear Education Transfer project office runs short-term Train-the-Trainer courses designed for university professors and postgraduate students from abroad. We share both technical knowledge and teaching methodology, helping foreign universities build their own nuclear education programs.

— What topics do these courses cover?

— They focus on Rosatom's key export technologies, including large VVER-1200 reactors and RITM-200 small modular reactors, plus non-power applications of nuclear energy like nuclear medicine, multi-purpose irradiation centers, research reactors, and cyclotrons. In recent years, we have added training on nuclear infrastructure. In addition, we have successfully piloted courses on radioactive waste disposal facilities and strategic energy planning for newcomer countries. Looking ahead, we plan to expand into renewable energy technologies and power supply scenario modeling, and develop a new course on nuclear energy program implementing organization (NEPIO).

Train-the-Trainer courses are offered in all formats: in-person, online, hybrid, and self-paced. This year, we have had participants from over 40 countries, including newcomers like Somalia and Malawi.

— Which topics are most in demand?

— Courses on research reactors, SMRs, and nuclear medicine consistently attract the most interest.

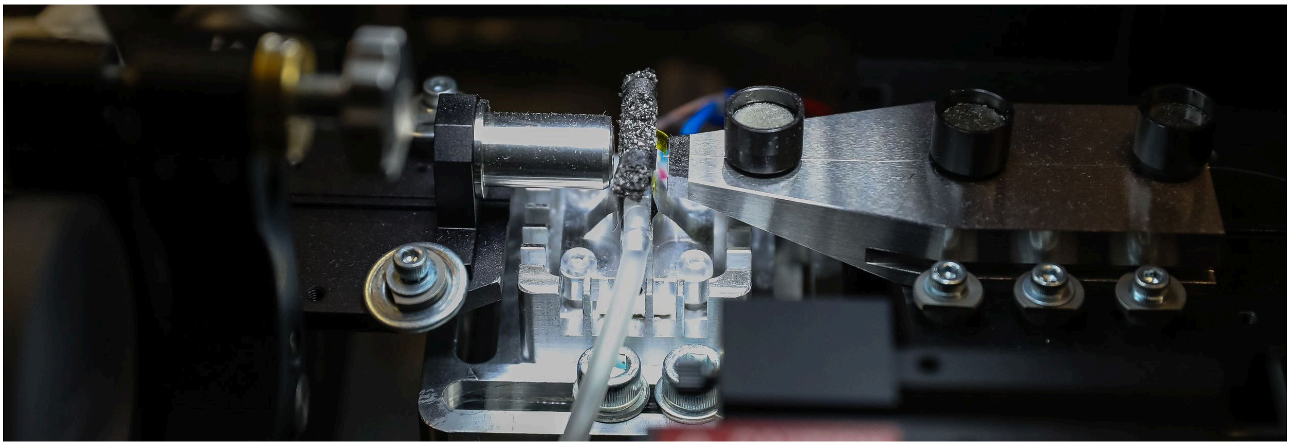
— How are the courses organized?

— Courses are typically held upon request from a sectoral customer. Enrollment usually opens 2–3 months in advance. Most courses last 1–2 weeks; more advanced programs may require entrance testing. At the end, there is a final assessment, with a chance to retake if needed.

Photo by: Rosatom Technical Academy

BRICS Quantum Forum

An international forum on quantum technologies is set to take place in Russia in 2026. The event has officially been added to the BRICS Science, Technology and Innovation Calendar of Activities. This follows the 17th BRICS Summit held July 6–7 in Rio de Janeiro, where member nations expressed strong support for advancing quantum technologies.



Quantum Forum put on the calendar

The international forum on quantum technologies has now been formally included in the BRICS Calendar of Activities.

One of the key players behind Russia's national quantum ecosystem is Rosatom, which collaborates with academic institutions, universities, industrial companies, and startups to push the frontier of quantum research. Under a 2020 agreement with the Russian government, Rosatom has been leading the country's quantum computing efforts. Starting in 2026, the Russian nuclear corporation will also oversee the development of quantum sensors. Rosatom's quantum program provides for the continuation of fundamental research while prioritizing the real-world application of quantum technologies across the nuclear sector and other industries. A major component of the program is the expansion of quantum education.

Rosatom is also championing global collaboration in the quantum space. "With the high potential we have, we are strong advocates for fair and open access to advanced technologies because the ultimate goal of scientific and technological progress is to improve the quality of life worldwide. That is why we fully support the inclusion of quantum technologies in the BRICS agenda and welcome opportunities for international collaboration," said Ekaterina Solntseva, Director for Quantum Technologies at Rosatom.

In the declaration following the 13th Meeting of BRICS Science and Education Ministers—held alongside the Rio summit—quantum technologies were recognized as a top priority: "We highly appreciate the Brazilian proposal to consider artificial intelligence, quantum technologies and innovation in industry as priorities in 2025, in a novel context of rapid advancement of emerging technologies and national reindustrialization processes. These themes have been emphasized in various BRICS STI dialogues and initiatives in the current year." It is worth noting that the United Nations has designated 2025 as the International Year of Quantum Science and Technology.

Russia's quantum evolution

Russia's national quantum program gained momentum in 2020 with the signing of several roadmaps focused on quantum technology. One of them, the Quantum Computing roadmap coordinated by Rosatom, resulted in the creation of functioning quantum computers on all four of the priority platforms: a 50-qubit ion trap system, a 50-qubit neutral atom system, a 35-qubit photonic processor, and a 16-qubit superconducting circuit system. Researchers have also developed 34 quantum algorithms targeting areas like quantum optimization, quantum chemistry, simulation, and big data analysis. A domestic cloud platform has been created to eventually provide remote access to these quantum processors. The focus through 2030 will shift toward practical application of quantum technologies across industries, with the nuclear sector taking the lead.

Russian researchers are setting ambitious goals, scaling up quantum registers (increasing qubit counts), improving operational fidelity, and miniaturizing quantum devices. By 2030, Russia aims to produce a 300-qubit quantum processor and, more importantly, start solving real-world problems.

Potential applications include optimization tasks, discovery of new materials (including pharmaceutical compounds), personalized medicine, and more efficient logistics operations.

Quantum technologies are already being tested in the nuclear sector. For instance, quantum-inspired algorithms were used to optimize long-term production planning and nuclear fuel delivery, improving resource allocation and production efficiency for the Proryv (Breakthrough) Project, Russia's initiative to develop a Generation IV nuclear power system.

"Rosatom is cautiously advancing in the application of quantum computing — in logistics, engineering, and nuclear fuel operations. And when it comes to Generation IV nuclear power plants, we believe quantum technologies are not just helpful — they're essential," said Rosatom Director General Alexey Likhachev, speaking at the Quantum Breakthrough: From Investment in Research to Business Projects business breakfast during the Saint Petersburg International Economic Forum in June 2025. "Now is the time to learn how to solve industrial challenges using quantum computing and algorithms. We need to be ready to act once scalable, industrial-grade quantum machines arrive."

Photo by: Strana Rosatom Newspaper

Global Balance

For the past few decades, the world's largest consumers of uranium as fuel for nuclear power plants and uranium producing countries have rarely overlapped. But now, the situation is gradually shifting as nations with nuclear power plants are taking steps to launch, restart, or significantly expand domestic uranium mining, while uranium-rich countries are planning to build nuclear power stations of their own. Rosatom is involved in both of these trends, driving the advancement of nuclear technology around the globe.

Historically, major uranium-producing regions have been geographically different from major uranium-consuming countries. Kazakhstan, Australia, Namibia, Uzbekistan, and Niger export all the uranium they produce. Conversely, European countries and the United States import nearly all the uranium they need. South Africa, India, and China import part of their required uranium supply. Russia — and to some extent, China — have pursued a different strategy, establishing uranium mining ventures in other countries. For Russia, the most successful and enduring partnership has been with Kazakhstan.

In recent years, nuclear energy has experienced a new renaissance, and the situation described above is beginning to change. Kazakhstan, Uzbekistan, and Namibia are taking steps toward building their own nuclear power plants, while the United States, Brazil, Argentina, and Sweden are planning not only to expand their nuclear fleets but also to revive domestic production of natural uranium concentrate.

Kazakhstan

For over 15 years, Kazakhstan has been the world's top uranium producer. In 2024, the country produced 23,270 metric tons of uranium, partly through joint ventures with Rosatom.

All Kazakh uranium is exported as the country no longer has operating nuclear stations after the reactor at the Mangystau Nuclear Power Plant was shut down in 1999.

But that is about to change. Last year, Kazakhstan held a national referendum and received public approval to build nuclear capacity, with several reactors planned. The first nuclear power plant will be constructed by an international consortium led by Rosatom, whose bid was selected as the best option by Kazakhstan's Interagency Commission on Nuclear Industry Development. At this June's Saint Petersburg International Economic Forum (SPIEF), Rosatom Director General Alexey Likhachev and Almasadam Satkaliyev, Chairman of the Republic of Kazakhstan's Atomic Energy Agency, signed a roadmap outlining key steps for a large nuclear capacity project in the country. Kazakhstan Nuclear Power Plants and Rosatom's engineering division AtomStroyExport inked a framework agreement defining the core cooperation principles for the construction project in the Zhambyl District of the Almaty Region.

Top 3 countries by uranium production (tU, WNA data, 2022):

Kazakhstan – 21,227
Canada – 7,351
Namibia – 5,613

Uzbekistan

Uzbekistan is one of the world's leading uranium producers. According to the World Nuclear Association (WNA), the country mined an estimated 3,300 metric tons of uranium in 2022, but it has never had nuclear power plants.

Uzbekistan is entering the nuclear era with Russian-designed small modular reactors (SMRs). In 2024, Rosatom signed a contract with the country's government to build six power units equipped with 55 MW RITM-200 reactors, with the first unit scheduled to come online in 2029. This is the world's first export contract for the construction of an SMR nuclear power plant. Site preparations are now underway in Uzbekistan's Jizzakh Region, while Russia has begun manufacturing the first reactor for the plant. Also at SPIEF, Rosatom and the Agency for the Development of Nuclear Energy under the Cabinet of Ministers of Uzbekistan signed an agreement to study the feasibility of constructing two (potentially four) power units with 1 GW VVER-1000 reactors in Uzbekistan.

Namibia

The country produced 8,283 metric tons of uranium in 2023, according to the Namibian Uranium Institute. A game-changer could be Rosatom's Wings project, which may unlock a new uranium mining region and boost economic development in eastern Namibia.

In addition, Namibia intends to begin discussions on building a nuclear power plant. This was announced by President Netumbo Nandi-Ndaitwah: "While I cannot say when Namibia will have a nuclear power station, I can assure you that discussions will definitely begin within this financial year." Domestic power generation is a critical goal as Namibia depends on electricity imports from South Africa, which are often unstable. President Nandi-Ndaitwah emphasized the need to fully leverage the country's mineral potential. "We must not only export minerals but also process them here. We must claim our place in the value chain," she said.

Rosatom is ready to support these plans. "Nuclear can lay a solid foundation for sustainable energy systems in African countries. Rosatom has developed a wide range of solutions to achieve this goal. […] We are delighted that Namibia is exploring the possibilities of nuclear power. This decision could make the country a major energy player on the African continent," said Ryan Collier, CEO of Rosatom Central and Southern Africa, speaking last autumn at the 2nd Nuclear Science and Technology Conference in Namibia.

Top 3 countries by installed nuclear capacity (GW, IAEA data, 2025):

United States – 96.95
France – 63
China – 55.32

Brazil

Currently, Brazil operates two reactors at its Angra NPP with a combined capacity of 1.88 GW. The country is exploring options to expand its nuclear fleet and increase uranium production. Implementing these plans involves cooperation with Rosatom. This May, Brazilian President Luiz Inácio Lula da Silva said during a meeting with Russian President Vladimir Putin that Brazil was interested in collaborating with Russia on building small modular reactors. Additionally, the Brazilian government and Rosatom are holding talks on joint uranium and lithium mining projects in the country.

Sweden

Sweden has not mined uranium for at least 15 years, and a 2018 ban halted production entirely. But last year, the Swedish government released a report after a comprehensive review that lifting the ban would be advisable. A corresponding bill is expected to be submitted to the national parliament before January 1, 2026. Foreign exploration companies with projects in Sweden are lobbying hard for this move.

Sweden currently operates six nuclear reactors with a total capacity of 7 GW. The government has announced that 2.5 GW of new nuclear capacity must be built by 2035. An additional four to ten new units (final decision pending) are expected to be constructed over the next decade.

Argentina

Argentina currently operates three reactors at two plants, two at Atucha and one at Embalse, with a combined capacity of 1.64 GW. In December 2024, the national government unveiled its nuclear development strategy. Argentina's Nuclear Plan provides for the construction of a domestically designed SMR at the Atucha site, modernization of nuclear infrastructure, and revival of uranium mining in the country. According to WNA, Argentina has not produced uranium for at least the past 12 years. The Nuclear Plan caught the attention of French President Emmanuel Macron. At June's UN Ocean Conference in Nice, he agreed with Argentine President Javier Milei on cooperation in implementing the Nuclear Plan and signed a memorandum of understanding on collaboration in developing the so-called 'critical' minerals, including uranium.

USA

In May 2025, U.S. President Donald Trump signed four executive orders aimed at expanding the nation's nuclear power capacity from nearly 97 GW today to 400 GW by 2050. The target for 2030 is to add 5 GW through upgrades to existing units and to begin construction of 10 new large reactors. One of the orders calls for developing a plan to expand uranium conversion and enrichment capacity sufficient to meet U.S. demand for low-, medium-, and high-enriched uranium. Another sets the goal of making American nuclear companies preferred partners, targeting at least 20 new 123 Agreements as a foundation for further international nuclear cooperation.

The United States is also seeking to increase domestic uranium production. So far, progress has been limited. According to the Energy Information Administration's report for the first quarter of 2025, uranium output — already weak — declined further to 310,533 pounds of U3O8 (less than 120 metric tons), roughly 65,000 pounds (25 metric tons) less than in the fourth quarter of 2024.

Russia

Rosatom is a global nuclear leader operating in more than 60 countries. Its overseas construction portfolio includes 33 large reactor units in 10 countries and the world's first export project for six small modular reactors to be built in Uzbekistan.

Russia offers assistance to friendly nations worldwide in the development of both uranium mining and nuclear generation, while expanding its own reactor fleet and uranium output. Its national Power Plant Location Master Plan provides for the construction of 38 new reactors of various capacities by 2042. Total installed capacity will grow by 18.9 GW from the current 26.8 GW, and the share of nuclear power in the country's energy mix will rise to 25%. Plans also include increasing uranium output from domestic mines.

39 reactors

Rosatom's international portfolio of nuclear construction orders

Some takeaways

Given the chronic underinvestment in both nuclear and uranium sectors, it is difficult to predict exactly which plans will materialize and how fast. However, the trend is unmistakable: governments, nuclear plant operators, and uranium companies are racing to secure the supply chain from ore to reactor, aiming to build domestically any missing links in the nuclear fuel cycle wherever possible.

More broadly, they aim at achieving full vertical integration in the home country. And building nuclear power plants in tandem with uranium mining is the most straightforward, cost-effective, and technologically feasible option.

China's strategy is not discussed separately here, as it remains consistent: the country is steadily constructing new reactors and actively securing uranium supplies, including through domestic resources.

This article does not aim to balance projected demand against consumption, especially over specific timelines. Still, it is evident that Kazakhstan and Uzbekistan prioritize self-sufficiency, planning to build their own nuclear plants. The same will likely apply to Namibia, Brazil, Argentina, and indeed any country that both mines uranium and operates nuclear plants. This means their uranium output will no longer be available to other buyers.

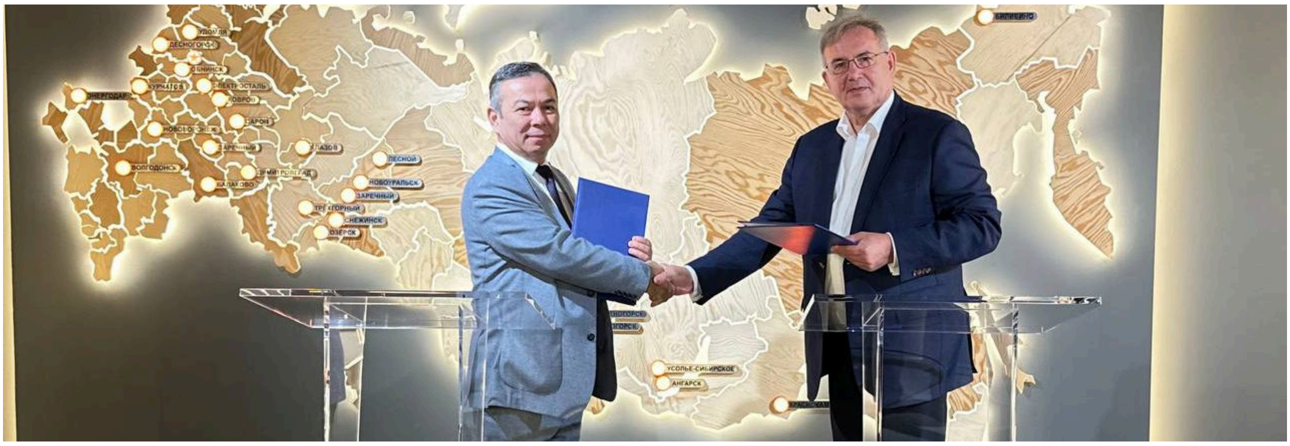
Yet this is not the kind of risk that investment analysts often highlight to stoke fears of an imminent uranium shortage and price surge. The global nuclear industry has long been producing more power than it mines uranium for. It is also important to note that the uranium market is increasingly moving away from spot trading, with real transactions shifting toward long-term contracts. Since July 2024, the long-term price has remained stable at around USD 80 per pound of U3O8, ignoring fluctuations in the spot price.

Long-term contracts involve large supply volumes and extended planning horizons. They require consistent solutions and sustained investment in new deposits, reliable mining operations, and closing the nuclear fuel cycle by reprocessing spent fuel and utilizing depleted uranium. Together, these measures ensure long-term operation of nuclear power capacity. This is precisely what Rosatom and Russia as a whole are doing. That's why partnering with Rosatom means reliability.

Photo by: ASE, Kazatomprom, Wikipedia

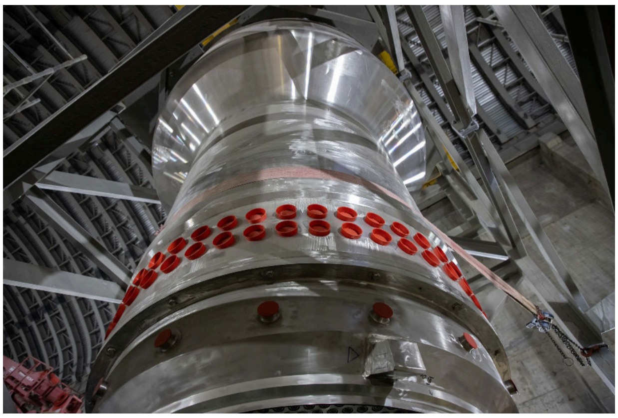
Uzbekistan Joins MBIR Project

Russia and Uzbekistan have signed an agreement on cooperation in international scientific research. The Nuclear Physics Institute of Uzbekistan's Academy of Sciences has joined the consortium that will operate MBIR, a Generation IV multi-purpose research reactor.



MBIR is the largest research reactor currently under construction in the world. It is being built in Dimitrovgrad (Russia) at the site of the Research Institute of Atomic Reactors (RIAR, part of Rosatom's research division).

MBIR will be operated by the International Research Center (IRC), which is intended to become a global platform for applied and fundamental research. Currently, more than 20 countries and organizations are already involved in the project. The IRC functions as a consortium whose primary scientific body — the Advisory Council—brings together scientists from around the world. Council members will define and coordinate key research programs, and monitor their implementation.



By joining the consortium, scientists from Uzbekistan will gain access to the research platform and have the opportunity to take active part in developing the experimental program for MBIR.

"The accession of Uzbekistan's Nuclear Physics Institute to the consortium will bring new opportunities for both Russian and Uzbek science. This primarily includes fundamental research in the experimental validation of theoretical models for the behavior and interactions of particles under extreme conditions, testing hypotheses about the nature of fundamental forces and symmetries, and searching for new states of matter and exotic phenomena," said Vasily Konstantinov, CEO of MBIR IRC Consortium Leader (part of Rosatom).

"We are proud to become part of this one-of-a-kind MBIR consortium. With its Generation IV reactor as an essential tool, our scientists will be able to do cutting-edge research, advancing future-oriented fields of study," emphasized Ilkham Sadykov, Director of the Nuclear Physics Institute of Uzbekistan's Academy of Sciences.

MBIR specifications and capabilities

MBIR has 150 MW of thermal power and 55 MW of electric power— exceptionally high figures for a research reactor. Beyond its record-breaking power, MBIR boasts other unique features. For example, its extremely high neutron flux density will allow scientists to study the behavior of materials in a relatively short time, whereas other nuclear facilities would require decades to achieve equivalent radiation exposure.

Another distinctive feature of MBIR is its ability to accommodate several independent loop units with different types of coolants (sodium, lead, lead-bismuth, gas, and others). This will make it possible to simultaneously model operating conditions of reactors with various coolants and explore structural and fuel materials to validate Generation IV reactor concepts.

MBIR will have a three-circuit heat transfer scheme, with sodium used as the coolant for the first and second circuits and water for the third circuit. The reactor will be equipped with a steam turbine, handling systems, loop units, vertical and horizontal experimental channels, a set of research shielding chambers, and laboratory facilities.

As fuel, MBIR will use mixed-oxide (MOX) fuel, a blend of plutonium oxides extracted from spent nuclear fuel and oxides of depleted uranium, a by-product of uranium enrichment.

Research at MBIR

MBIR will replace BOR-60, a 60 MW fast neutron reactor launched in 1969 and remaining in high demand among both Russian and international companies. After extensive modernization financed by the government, its operational lifespan was extended until the end of 2028.

MBIR will continue in-pile and post-irradiation material studies and will be used to validate production technologies for radioactive isotopes and modified materials. Most importantly, MBIR will expand studies into closed nuclear fuel cycle technologies. It will also support the validation of solutions for the fourth generation of nuclear facilities.

In 2021, a national program for advanced experimental research at MBIR was approved for the period of 2028–2040. In addition to conventional fields of study, the program provides for potential non-energy applications, such as conducting biomedical research at MBIR. It will facilitate boron neutron capture therapy for treating certain cancers, as well as neutron doping of silicon for its subsequent use in electronics.

Photo by: JSC SSC NIIAR, RMS

VVER-1200: Flagship Reactor for Kazakhstan

Work has begun in Kazakhstan to build a large nuclear power plant featuring VVER-1200 reactors. The project is being implemented by an international consortium led by Rosatom. Below, we take a closer look at this reactor type and how it ensures safety and efficiency of nuclear generating stations.

August 8 saw the start of engineering surveys near the town of Ulken, Almaty Region, on the shore of Lake Balkhash to select the optimal site for the nuclear power plant and prepare design documents. Rosatom's Engineering Division started drilling the first exploratory borehole and collecting soil samples. These surveys will help assess seismic stability, hydrogeological conditions, and other site-specific parameters that are crucial for safety and reliability of the future station. At least 50 boreholes, ranging 30 to 120 meters deep, will be drilled during this phase. The collected data will inform the final decision on the plant's exact location.

"The start of engineering surveys in Ulken marks the first step toward Kazakhstan's first large nuclear power plant in modern history. At this stage, we focus our efforts on thoroughly studying the site to be fully confident in its suitability for the future nuclear station. Rosatom is ready to leverage its full expertise to deliver this project of strategic importance for Kazakhstan's development," said Alexey Likhachev, Director General of Russia's State Atomic Energy Corporation Rosatom.

VVER-1200: leading the pack

The nuclear power plant in Kazakhstan will feature VVER-1200 reactors. These are pressurized water reactors (PWRs), the design that was developed in the early days of civil nuclear technology and now dominates global nuclear power. According to the IAEA, out of 416 operating reactors worldwide, 306 are PWRs.

Among this large international family, Russian VVERs hold a key position. They form the backbone of Russia's nuclear energy sector, with a long history of safe operation and continuous advancements in efficiency and safety.

The VVER-1200 is Rosatom's flagship Generation III+ reactor — the most advanced, technologically sophisticated, and safest Russian design to date. It incorporates decades of experience in engineering and operating reactors of the same type. Its design life is 60 years, extendable by another 20. Other key features of the VVER-1200 include load-following capability, a high (90%) capacity factor, and the ability to operate for 18 months without refueling.

The VVER-1200 reactor unit has two circuits. The primary circuit—sealed and pressurized—contains the reactor core, where nuclear fission releases a massive amount of energy and heats the coolant, a chemically purified boron-treated water that circulates through the reactor under high pressure (16.2 MPa) and temperature (up to 328.8°C). The coolant circulates in the primary circuit via four powerful circulation pumps.

The heated water from the reactor flows into steam generators, where it transfers its heat to water in the secondary circuit. This causes the secondary water to boil and produce steam.

The two-circuit design ensures complete isolation between the circuits, meaning the water inside the reactor never physically contacts the water in the steam generators. Heat transfer occurs only through the heat exchange surface. This prevents any radioactive water from escaping beyond the primary circuit.

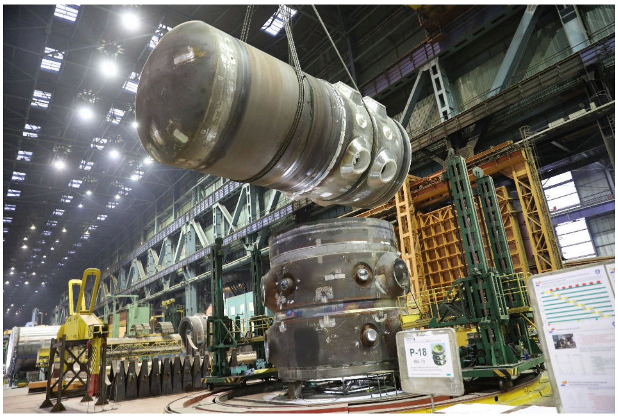
The generated steam is then carried through large steam lines to the turbine, where its energy spins the turbine shaft. The rotating shaft drives the electric generator, which produces electricity. The electricity generated is sent to step-up transformers and then, via gas-insulated transmission lines, to the switchyard and onward into the power grid.

Safety first

The VVER-1200 reactor unit is designed to withstand extreme, low-probability events, such as magnitude 9 earthquakes, tornadoes and hurricanes with wind speeds up to 60 m/s, tsunamis, and waves up to 10 meters high.

The design incorporates independent — active and passive — safety systems. Active safety systems are intended to quickly respond to possible accidents and emergencies. Passive safety systems function without operator intervention and even without power. It is impossible to cover all safety systems in a short article, so we will highlight just a few.

One of the most important passive safety devices — a Russian nuclear innovation — is the so-called 'core melt trap'. It is a 144-tonne steel vessel that, in the event of an accident, reliably contains fragments of molten reactor core and prevents them from escaping beyond the reactor building's containment structure.



Another passive safety component is the emergency core cooling system, designed to cool the reactor core using a volume of water many times greater than the reactor's own volume. Like the reactor control and protection system, it continues operating for 72 hours even after a complete power outage.

One more innovation, the passive heat removal system (PHRS), ensures the removal of residual heat from the reactor core through the secondary circuit.

VVERs conquer the world

Rosatom is building VVER-1200 units around the world. The two largest nuclear construction projects by Rosatom are the Akkuyu Nuclear Power Plant in Turkey and El Dabaa Nuclear Power Plant in Egypt. At both sites, four VVER-1200 units are being built simultaneously. The Paks II Nuclear Power Plant in Hungary, with two VVER-1200 reactors, is the first such project in the European Union. The Rooppur NPP in Bangladesh also consists of two VVER-1200 units, both of which are under active construction. Rosatom is also involved in building two nuclear plants in China: Units 3 and 4 at Xudabao NPP and Units 7 and 8 at Tianwan NPP, all featuring VVER-1200 reactors.

"VVER-1200 reactors are already operational in Russia and abroad, four units in Russia and two in Belarus. This technology has also been selected by our partners in Hungary, Egypt, Turkey, Bangladesh, and China. There is still much work ahead, and we count on support and assistance from the leadership of both Russia and Kazakhstan," said Rosatom Director General Alexey Likhachev.

Photo by: Rosatom, Atomenergomash

Russia and Bangladesh: Energy, Science, Culture

Rosatom is actively promoting collaboration with Bangladesh. Hot functional tests have begun on the first reactor of the Rooppur Nuclear Power Plant; Bangladeshi students submitted a record number of applications for the Icebreaker of Knowledge expedition, and Russian paintings were displayed as part of the Rosatom Territory of Culture program.

Unit 1 of the Rooppur Nuclear Power Plant has entered one of the most critical pre-commissioning stages as hot functional tests began on the reactor. During the tests, the reactor is gradually heated up, while engineers methodically assess the performance of key components — pumps, pipelines, and heat exchangers — under these conditions. It is essential to monitor how the equipment behaves in operation to make sure it will be safe and reliable once the plant is up and running.

In fact, hot functional testing is a comprehensive reliability check of the reactor unit before moving on to the next, more critical phases. This process demonstrates whether the reactor is ready to function under near-real conditions and how smoothly all systems work.

Icebreaker of Knowledge

The sixth Icebreaker of Knowledge expedition, organized with support from Rosatom, has come to an end. The Icebreaker of Knowledge is Rosatom's educational initiative targeting talented and curious students aged 14 to 16. This year, 65 students traveled to the North Pole aboard the nuclear icebreaker 50 Let Pobedy. All of them are winners of open Russian and international selections, as well as other federal, regional, and industry-wide competitions. The sixth expedition is dedicated to the 80th anniversary of Russia's nuclear industry and the 500th anniversary of the Northern Sea Route exploration.

This year, Bangladesh set a record with 841 applications for the competition. In total, applications were filed by about 4,000 students from 20 countries (including Armenia, Bangladesh, Belarus, Bolivia, Hungary, and others). Twenty international students were selected to take part. "Let's stay on the top of the world", said Mahmud Al Abdullah from Bangladesh.

The international selection process began on April

28, 2025, on Goarctic.energy website and included three stages. In the first stage, international participants completed a science quiz. The second stage featured a series of webinars on Rosatom's breakthrough technologies, including those used to ensure safe Arctic shipping. After viewing the materials, each contestant had to test their knowledge and make a summary. In the final round, top-scoring candidates presented short videos on how nuclear technologies could improve life in their countries. These creative entries were evaluated by an international panel of experts from the Icebreaker of Knowledge 2024 expedition, the ITER Project Center, the Russian Quantum Center, and Russian nuclear fleet operator Atomflot. Key selection criteria included depth, coverage, originality and creativity of the video presentations. Some members of the expedition became the first representatives of their countries ever to reach the North Pole. We will share more details about the expedition in our next issue.

Russian art exhibition

The Russian Embassy and Russian Center of Science and Culture in Bangladesh hosted an art exhibition titled “Images of Russian History”. It was organized under the Rosatom Territory of Culture program, with support from the Engineering Division of the Russian nuclear corporation. The exhibition was one in a series of events dedicated to the 80th anniversary of Russian nuclear industry.

Visitors had the chance to view reproductions of iconic works by Viktor Vasnetsov, Nicholas Roerich, Mikhail Vrubel, Valentin Serov, Ivan Shishkin, and other celebrated artists from the collections of the State Tretyakov Gallery and the State Russian Museum. The artworks illustrated key milestones in Russian history — triumphs and hardships, spiritual highs and difficult trials, heroic feats, and everyday life.

The event was attended by government officials, representatives of public organizations, research and educational institutions, students, cultural figures, and members of the Soviet Alumni Association Bangladesh.

“The paintings on display offer valuable insights into how different generations of artists perceived their country and its past. These artworks show that history is not a static set of facts, but a subject of ongoing debate and reinterpretation,” said Oksana Konysheva, Head of Rosatom Territory of Culture.

Photo by: Rosatom, ASE, ROSIZO