



Rosatom's Highlights 2017

Rosatom keeps its character and closes the year with impressive results. December was a very hectic time for the Russian nuclear corporation as two new reactors were started up in Russia within a single week, long-awaited documents were signed to launch the El Dabaa project in Egypt, and a nuclear plant construction project was finally kicked off in Turkey. RN has picked Rosatom's biggest highlights of 2017.

January

New business development was Rosatom's motto of the month. Its landmark event was the signing of a partnership agreement with Lagerwey, a Dutch wind farm manufacturer. This event marked the start of wind power

projects in Russia. The foundation for them was laid in 2016 when Rosatom won the bid to construct three wind farms with a total capacity of 610 MW in the country. The Dutch company will transfer the manufacturing technology to Rosatom, with production to be set up at Atommas (Volgodonsk, Russia).

February

The third winter month was also full of momentous events for the Russian nuclear industry. And one of them was the start of commercial operation at the most advanced and powerful unit in the world. Unit 1 of Novovoronezh II became the world's first operating Generation 3+ reactor.

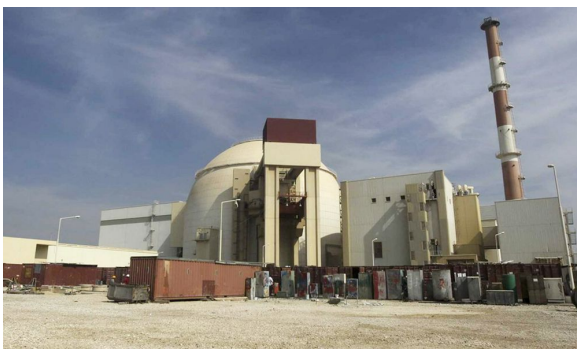
Rosatom also won a contract for its new product, a nuclear science and technology center. In February 2017, Rosatom and Zambia agreed to build it in the country.



Russia and Tajikistan signed an agreement on civil nuclear cooperation. The document was the first historical document signed between the two countries.

March

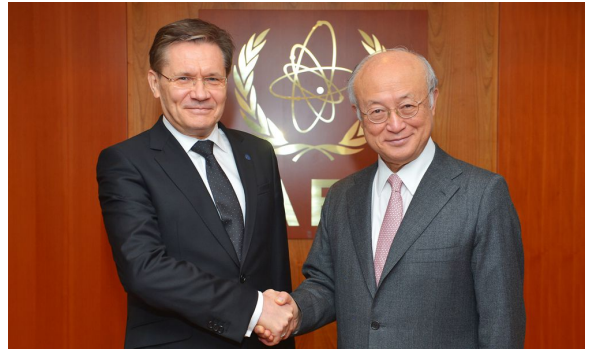
The first spring month brought Rosatom good news as the European Commission completed the investigation into Paks II construction project with Russia's involvement and gave it a green light. The Commission stressed that the Hungary-based project was fully compliant with the EU competition law.



Construction of Bushehr Unit 2 started in Iran on 14 March.

April

India's Kudankulam Unit 2 was transferred to the customer for warranty operation. The reactor unit will be tested for reliable performance under standard working conditions till 30 March 2018.



Rosatom and the IAEA agreed to jointly improve the nuclear infrastructure in emerging nuclear countries.

May

The last spring month was fruitful for Rosatom's TVEL Fuel Company, which signed nuclear fuel supply contracts worth a total of 1 billion US dollars with two Chinese companies. The fuel is intended for Tianwan NPP Units 1 and 2 built with Russia's input.

June

The first month of summer 2017 was packed with new contracts and conferences. One of the central events was the signing of a framework agreement for the third phase (Units 5 and 6) of the Kudankulam NPP construction project in India.



At Atomexpo 2017 held in Moscow, Rosatom made over 50 cooperation agreements and contracts. One of the most important was an agreement with Turkish investors joining the Akkuyu construction project.

Also in June, Yekaterinburg hosted an IAEA international conference on fast reactors. The event was attended by more than 500 experts from different countries.



Rosatom and Vietnam agreed to establish a nuclear center in the country. A memorandum to this effect was signed by Rosatom and the Ministry of Science and Technology of Vietnam at the end of the month.



The first batch of spent nuclear fuel was shipped from the repository at Andreev Bay for reprocessing. The shipment brought the end to 20 years of preparation for removal of spent fuel from the repository.

July

At Expo 2017 in Kazakhstan, Rosatom organized the Nuclear Week devoted to Russian nuclear technologies. The event drew capacity audience. Rosatom's exposition featured nuclear solutions for agriculture, medicine, water desalination, water treatment, space exploration, supercomputers, closed nuclear fuel cycle, superconductors, and thermonuclear fusion.

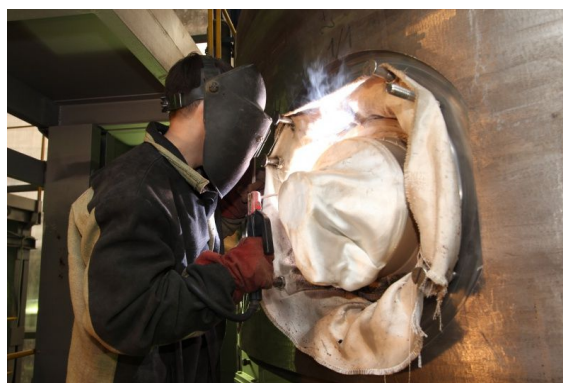


Construction of Kudankulam Units 5 and 6 entered the implementation stage. On 31 July 2017, AtomStroyExport and the Nuclear Power Corporation of India Limited (NPCIL) signed contracts for project engineering, detailed design and delivery of core machinery for Kudankulam III.

August

The second project phase at Tianwan NPP passed a key milestone as the Unit 3 reactor startup began on 18 August.

Rosatom's subsidiaries in Latin America also showed good results. Rosatom America Latina and UMATEX Group (Rosatom's subsidiary for composite materials) became members of the Latin American Composite Materials Association (ALMACO). The membership in ALMACO offers new opportunities for Russian companies in Latin America.



ZiO-Podolsk completed the most complex task of assembling the first reactor vessel for the RITM-200 unit to be installed on Sibir (Siberia), a Project 22220 nuclear icebreaker.

September

In early autumn, Rosatom won another international contract. The company's subsidiary Rusatom Healthcare and Thailand's Kinetics Corporation Ltd will jointly construct and commission a center for production of radiopharmaceuticals in Thailand. The center is aimed to support the development of Thai nuclear medicine. Later Rosatom took another step forward by signing a contract with A Brown Company Inc. to construct a network of agricultural irradiation centers in the Philippines.

In the same month, Rosatom continued expanding its wind power business. The newly established SC NovaWind will consolidate Rosatom's operations in the leading segments and technology platforms of the power industry.

In late September, the reactor of Tianwan Unit 3 achieved criticality, which marked the end of the startup phase. It is also notable that loading of all 163 fuel assemblies was completed ahead of the schedule.



The contract to construct a nuclear research center in Bolivia was signed in September at the IAEA General Conference in Vienna between Rosatom and the Bolivian Atomic Energy Agency. The center will have a 200 kW pressurized water reactor, a multi-purpose gamma irradiation unit, a cyclotron for pharmacological purposes, auxiliary facilities, and several research laboratories. Investments in the project will exceed 300 million US dollars.

Rosatom strengthened its ties with partners in Latin America and Southeast Asia. Cooperation agreements were signed with Paraguay and Cambodia at the IAEA General Conference.



The float-out ceremony for Sibir (Siberia), the first Project 22220 nuclear icebreaker, was held on 22 September. It took the Baltic Shipyard only two years and a half to prepare Sibir for the float-out.

October

Rosatom's irradiation technologies were in demand in the second autumn month, too. A memorandum on cooperation was signed with Morocco's CMI Développement to build irradiation centers and supply isotope products to the country's health care institutions.

Construction operations finally began at Bushehr II. According to the contract signed in November 2014, Russia will construct two new reactors with a total capacity of 2,100 MW near the existing unit.

Russia and Nigeria signed a set of agreements on construction and operation of a nuclear power plant and a multi-purpose research reactor in Nigeria. The two countries also signed a road map to jointly promote peaceful uses of nuclear power.

November

One of this month's landmark events was the beginning of Rooppur NPP construction in Bangladesh as the first concrete was poured in late November. The station will comprise two 1,200 kW VVER-based power units built to AES-2006 Generation 3+ design offering improved efficiency and compliance with the latest reliability and safety requirements.

December

Rosatom continued setting records in the run-up to New Year's Day. For the first time in the history of modern Russia, two reactors – one at Leningrad II and the other at Rostov NPP – were started up within a single week. Another notable event was the beginning of construction at Akkuyu in Turkey. As specified in the

limited construction permit, which is the first license obtained last October, Rosatom will start building the so called non-nuclear structures and facilities for the station.



This year's most anticipated event in international cooperation was the signing of contracts to construct a nuclear station in El Dabaa and supply nuclear fuel for its reactors.

IN FOCUS

Public Awareness of Nuclear Energy

Rosatom pays much attention to public relations. An information center opened its doors last week at Rooppur site in Bangladesh to deal with public concerns. You will find more details in our report.

The information center was opened in Ishwardi Upazila, Pabna District, Bangladesh. The opening ceremony was attended by representatives of the Bangladesh Atomic Energy Commission (BAEC), local administration, Yuri Koshelev, AtomStroyExport's Chief Engineer in Bangladesh, and Andrei Shevlyakov, Vice-President of Rosatom South Asia.

The new reception center located in the vicinity of the nuclear plant is one of the most effective communication channels



between local residents and representatives of Rosatom and BAEC. Visitors will have an opportunity to find out more about comprehensive nuclear solutions, unparalleled safety systems of Russian Generation III+ power units, and the construction progress at Rooppur.

"We all know that Bangladesh is making towards nuclear generation, and the Rooppur nuclear power plant is engineered to ultimately ease power shortage. But a nuclear plant is more than just a power source. It offers new jobs, new knowledge, industrial development, and scientific progress. Here in the center, we welcome public authorities, non-

governmental organizations, mass media, teachers of vocational and higher education institutions and, of course, students who tomorrow might want to become nuclear plant operators or even nuclear construction engineers,” said Alexander Khazin, ASE Senior Vice President for Foreign Projects.

“Nuclear safety is Rosatom’s primary concern. Then, we are also concerned with improvement of the public attitude towards nuclear power. Our approach to public awareness is based on an open dialog with every stakeholder, including industry experts, students, journalists and authorities. We make no exception and this is what makes us different,” added Andrei Shevlyakov, Vice-President of Rosatom South Asia.

As you know, the first concrete was poured for the basement of Unit 1 on the plant’s site in late November. This marked the beginning of a construction process that will result in the country’s first power generation facility with a service

life of no less than a century. The first concrete pouring ceremony took place less than a month after the Bangladesh Atomic Energy Commission (BAEC) obtained a construction license for the country’s first nuclear power plant. The Rooppur Nuclear Power Plant will have the latest Generation 3+ units with VVER-1200 reactors. The world’s first reactor of this class was brought online earlier this year at Novovoronezh II in Russia. It is an evolution of Generation 3+ reactors and is fully compliant with international safety standards. In 2017, the new unit of Novovoronezh II was named the world’s Top 3 nuclear reactor unit by the POWER Magazine (USA).

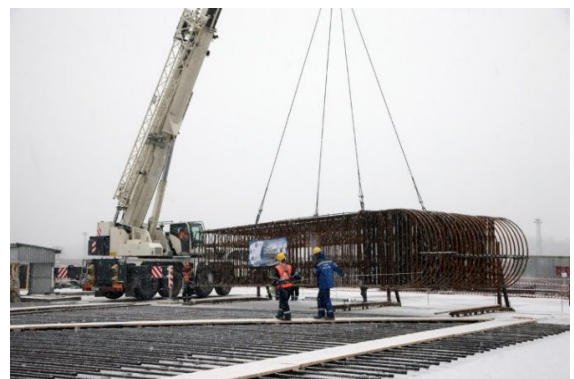
The Rooppur project is based on the defense-in-depth concept, which is fundamental for the plant’s overall safety. This concept provides for multiple defense levels and mitigation of accidents and human error, thus securing environmental safety.

CONSTRUCTION

Kursk II Passed Construction Milestone

Kursk II began reinforcing the foundation slab for the reactor building of Unit 1. This operation became the year’s key event on the construction site of the Kursk plant.

On 21 December, the first 16-ton reinforced concrete block was installed on the rebar of the lower foundation belt. According to the project design, the foundation comprises 105 reinforced concrete blocks with a total weight of 1,600 tons. This will enable the construction team to start concreting the foundation slab of the reactor building in the first half of 2018.



Prior to putting the first concrete block, a rebar coupler engraved with the words “The future is shaped today. The first coupling sleeve of the innovative VVER-TOI power unit” was ceremonially installed into the foundation reinforcement.

VVER-TOI (which means ‘a standard optimized and automated power unit based on VVER technology’) reactors meet Russian and global safety requirements and have a longer service life and higher installed capacity than existing reactors of the Kursk Nuclear Power Plant.

Alexander Mikhailov, Governor of the Kursk Region, noted that it was an honor for the region to build and commission one of the world’s first nuclear plants with advanced VVER-TOI reactors. “Construction of Kursk II designed to meet the latest global standards offers our region development prospects for the entire 21st century. Just a few Russian regions have such opportunities,” he stressed.

Vyacheslav Fedyukin, Director of Kursk NPP, noted it was symbolic that the event happened on the 25th anniversary of RosEnergAtom and 10 years after the foundation of Rosatom, the companies that shaped the newest history of Russia’s nuclear industry. “Construction of Russia’s first VVER-TOI-based power unit proves that the national nuclear power industry is always at the cutting edge of science and engineering. The new

generation VVER-TOI units are state-of-the-art facilities made to the best of Russia’s nuclear engineering knowledge,” he added.

At the moment, other operations are also underway at the construction site of Kursk II. Among them is excavation of 1.2 million cub m of soil to be completed in 2017, with over 800,000 cub m of sand, gravel and aggregate already put in the foundation of Kursk II buildings and structures. Construction of a 330/10 kV substation and preparation of technical documents for its commissioning are also drawing to a close.

For reference:

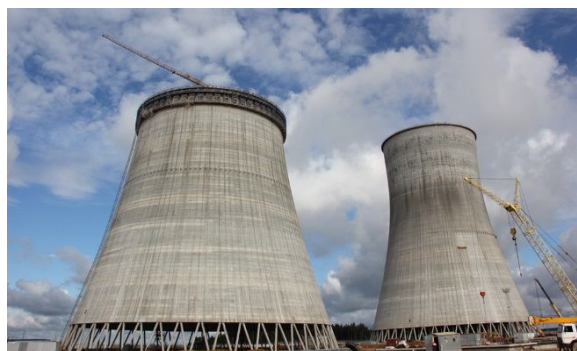
Kursk II is designed to replace the existing Kursk Nuclear Power Plant that will be taken out of operation in the years to come. Its first two units with VVER-TOI, a new-type reactor, will be commissioned simultaneously with decommissioning of Units 1 and 2 of the existing nuclear station. According to the master schedule of Kursk II, Unit 1 will be commissioned in late 2023 to be followed by Unit 2 in late 2024.

COOPERATION

Nuclear Power Plant for Sudan

Rosatom continues strengthening its ties with its Sudanese colleagues. Last week Russia and Sudan countries signed an agreement on nuclear plant construction in the African country.

The document was signed by Dmitri Bazhenov, Marketing & Business Development Director at Rusatom Overseas (a Rosatom Group company),



and Musa Omer Abu El-Gasim, Undersecretary of the Ministry of Water Resources and Electricity of Sudan.

The parties agreed to carry out a feasibility study for the construction of a nuclear power plant in Sudan. The study includes site surveys and estimation of key project parameters, such as technical solutions to be used, capacity, core equipment, project schedules and milestones, and financing mechanisms.

“A nuclear power plant can help Sudan deal with its energy security problem. It is a large-scale, strategic project which will set the pace for relationships between our countries for years ahead,” Dmitri Bazhenov said.

Civil nuclear cooperation between Russia and Sudan started earlier this year after Sudanese President Omar al-Bashir visited Sochi (Russia) on 24 November 2017 and signed a framework agreement with Russia on peaceful uses of nuclear energy. The agreement was preceded by the memorandum of understanding made between Rosatom and the Ministry of Water Resources and Electricity of Sudan in June within on the margins of Atomexpo 2017 held in Moscow.

IN BRIEF

Rusatom Service Made the First Shipment of Spare Parts to Bushehr

In October 2017, Rusatom Service and Nuclear Power Production & Development Co. of Iran (NPPD) signed a contract to supply spare parts for Bushehr. The contract provides for four shipments of spare parts that will be used for scheduled repairs at the Bushehr Nuclear Power Plant. The maintenance is scheduled for February 2018. Spare parts were manufactured by ISKOM, Korporatsia Splay, AtomMashExport, Polzunov Association for Power Equipment Research and Design, EnergoKomplekt, Diakont, and Izhorskiye

Zavody. The first shipment comprises over 700 items. All four shipments will be delivered to Bushehr in January 2018.

RITM-200 Installed at Sibir Icebreaker

In Saint Petersburg, the Baltic Shipyard completed the installation of the second RITM-200 reactor on the new generation Sibir nuclear icebreaker. Installation of the first reactor was completed earlier, on 14 December. RITM-200 is an innovative pressurized water reactor developed and manufactured for the icebreaker fleet by AtomEnergMash, Rosatom’s engineering division. The new reactor unit is unparalleled for its compact size and cost efficiency. Its integrated design provides for the placement of core equipment inside the steam generator shell and makes the unit twice as light, half more compact and 25 MW more powerful than the existing icebreaker reactors of the KLT series. The reactor design enables the icebreaker to be used both in deep Arctic waters and river estuaries and improves its icebreaking speed and other performance indicators. The reactors have a service life of 40 years and are protected by a containment made of steel, water and concrete.

NPCIL to Adopt Novovoronezh Best Practices

Representatives of the Nuclear Power Corporation of India Limited (NPCIL) plan to adopt the best staff training practices of the Novovoronezh Nuclear Power Plant. Last week, the NPCIL delegation led by Chellappan Suresh Babu, Head of NPCIL office in Russia, visited the plant. The visitors learned about the Russian nuclear station structure, installation techniques, active and passive safety systems, and staff training procedures. “We would like to build the same staff training center in India like the one we saw at Novovoronezh. We liked very

much how its employees interact with each other and visitors. This is the practice we will certainly adopt in our country,” Chellappan Suresh Babu said. At Novovoronezh, the visitors were shown the staff training center, innovative Novovoronezh 2 Unit 1 with a Generation III+ reactor, central control room, indoor 500 kW switchgears, Novovoronezh 2

Unit 2 under construction, and the plant’s museum. The visitors were also taken on a city tour after which Mr. Chellappan Suresh Babu noted that, judging by his 30-year experience in nuclear, Novovoronezh was one of the best satellite cities located near nuclear plants.