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Rosatom Entering its 75th Anniversary Year

In 2020, Rosatom is celebrating the 75th anniversary of the Russian nuclear industry. Having turned into a global technology leader, Rosatom plays a major role in power and mechanical engineering, nuclear waste management, engineering design, uranium mining and other industries.

According to the provisional 2019 results announced in December by Rosatom's Director General Alexey Likhachev, annual revenue from overseas projects was expected to reach a record of USD 7.3 billion, up 10% compared to the previous year. The revenue growth is due to several construction projects that have entered the implementation phase. As of late 2019, Rosatom was constructing 25 reactor units in nine countries with agreements reached for the construction of total 36 power units in 12 countries.

In September, Rosatom submitted an engineering design project for Hungarian Paks-2 NPP and had it approved by the regulator ahead of schedule. One month later, Rosatom signed a contract with a French-German consortium of Framatome SAS-Siemens AG for the supply of main I&C systems.

At Akkuyu NPP, concreting of the basemat for the reactor building of Unit 1 was completed in March 2019. In July, a core catcher was delivered to the site. Site preparation for the start of construction was reached ahead of schedule. In early 2019, Rosatom and İÇTAŞ, one of the largest investment and construction companies in Turkey,

established a joint venture. In July, Akkuyu Nükleer signed an EPC contract with that company. The construction license for Unit 2 was obtained in August with the construction license for Unit 3 being expected in 2020.

In Egypt, the first package of licensing documents for the El Dabaa Nuclear Power Plant was submitted to the national regulator for approval. Engineering surveys have been completed, and preparations involving local companies are underway on the construction site.

In Finland, Rosatom is working under schedule to draft licensing documents, prepare the site for construction and sign contracts with machinery and equipment suppliers. For instance, a contract was signed in early October for the supply of main I&C systems for the Hanhikivi NPP.

Belarus NPP Unit 1 has entered the pre-operational phase. At Unit 2, a vehicle airlock was assembled and a generator stator was installed in its permanent position. The work is now underway to check and energize the plant's systems.

In India, core equipment and machinery for Kudankulam NPP Unit 3 was delivered to the construction site. Two steam generators were shipped for Unit 4.

Concreting of basemats for the turbine islands was completed at the both units of the Rooppur NPP in Bangladesh. At Unit 1, workers finished concreting the first level of internal containment structures of the reactor building. The core catcher was installed in its permanent position at Unit 2.

In China, Rosatom signed a general contract for the construction of Tianwan NPP Units 7 and 8 and an engineering design contract for Xudabao NPP Units 3 and 4. At the end of January, it became known that Russia and China wanted to begin construction of unit 7 of the Tianwan nuclear power plant in December 2020, five months earlier than originally planned. In addition, long-term contracts were signed for the supply of nuclear fuel for these power units.

New products offered by Rosatom include nuclear science and technology centers (NSTC). One of them is now under construction in Bolivia. **"Despite political tensions in Bolivia, we are optimistic about the NSTC construction project and its prospects,"** Alexey Likhachev said. Core components of the cyclotron, pre-clinical radiopharmacy and irradiation equipment have been delivered to Bolivia. The NSTC in this country is the first to be constructed abroad and will serve as a reference for other similar projects. Another NSTC will be built in Vietnam; intergovernmental agreements for the construction of NSTC were signed with Serbia and Rwanda in 2019.

Rosatom is strengthening its position in the nuclear fuel segment. In 2019, Rosatom signed a 2022-2030 fuel supply contract with Slovakia and expanded its presence in the uranium products market with deliveries carried out to 33 companies in 14 countries.

Rosatom is gaining recognition as a decommissioning market player. The Russian nuclear corporation joined a consortium that had won a contract for the dismantling of two boiling water reactors at Oskarshamn and two more at Barsebäck (both in Sweden). In addition, a Russian consortium of Rosatom Group companies won a contract to create a system that will collect duct from the fragmented molten reactor core at Fukushima's damaged reactors.

It is expected that Rosatom's portfolio of international contracts for the next 10 years will exceed USD 140 billion, up 5% compared to the previous estimates. The total price of contracts related to the plants' full service life is expected to reach USD 202 billion. Revenue from overseas projects in 2020 is planned to exceed USD 8 billion with more than a half coming from nuclear construction projects.

Rosatom continues working on promising projects. In particular, it has entered the second round of the international tender for the construction of a nuclear power plant in Saudi Arabia and participates in the strategic investor selection process for the Belene project in Bulgaria. The Bulgarian government is expected to make a decision on the investor already this year.

Small modular reactors are another area of focus for the Russian nuclear corporation. As for 2019, efforts were concentrated on connecting the Akademik Lomonosov floating nuclear power plant to the electricity grid. In 2020, Rosatom will focus on onshore small modular reactors.

The company also plans to expand its presence in non-nuclear segments. In 2020, it is expected that equipment for the cyclotron and radiopharmacy facility in Thailand will be supplied. A joint venture that will manufacture titanium products is planned with Hermith, a leading global producer of titanium alloys. Pilot additive technology and power storage projects are going to be launched in partnership with EdF (a French electric utility company).

This year, Rosatom will participate in anniversary events, including NDExpo (in March) and Atomex (in October). In late September and early October, Rosatom will take part in the World Atomic Week, which will host an international scientific conference dedicated to the 75th anniversary of the Russian nuclear industry.

Smart gadgets and wearable technologies

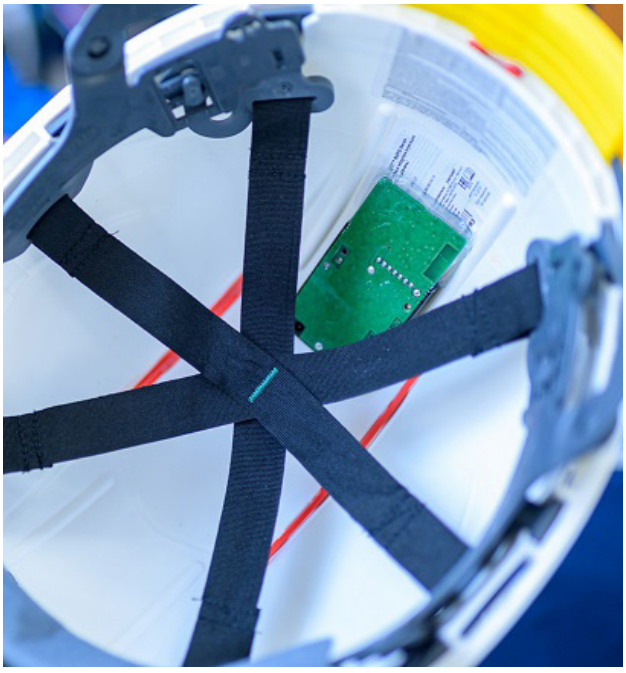
In order to ensure employees' safety, Rosatom uses tried and tested technology to keep an eye on people and tools remotely, including smart bands, smart hard hats and automatic tool storage cabinets.

Life-saving hard hats

The Smart Hard Hat project, commissioned in December, is a part of the Smart Mine, a larger-scale initiative carried out at Khiagda (a subsidiary of Rosatom's mining division) in eastern Siberia.

The project was delivered through the collaborative efforts of three companies. Two of them, Khiagda (client) and Rostelecom (Russia's largest digital services provider), financed the construction of a 200 km fiber optic line. Rostelecom also built the telecoms infrastructure at the Istochnoye mine where the project was piloted.

The third side, Softline, a leading global supplier of IT solutions and services, supplied 200 hard hats and other necessary equipment. The hard hats fitted with GPS trackers, communication modules and sensors that transmit data via radio channel were manufactured by the Suksun Optical and Mechanical Plant. The data is then transformed into text messages and, for example, when a worker puts his hard hat on his supervisor sees a message saying "Worker X: hard hat on."



The sensors are used to detect whether a worker fell, was hit, moved or did not, as well as position of the hard hat, for example, whether it is on its side or upside down. Then it is up to supervisors what to do regarding the received messages. For example, a weak hit is simply registered in the database. If a fall is detected and the worker remains motionless, the supervisor calls rescue services.

In addition, the hard hat has a temperature sensor. It helps limiting exposure to cold (the Russian labor law sets duration limits on working in cold weather) or detect a fire.

The hard hats do not have microphones because voice communication is impossible in deep mines. However, staff could call for help by knocking on the hard hat thrice. The sensors weigh as little as 40 grams, so wearing the smart hat is like wearing a "dumb" one.

According to the developers, smart hard hats will reduce the injury rate by about a third since workers become more disciplined – they could not carry the hats in hand anymore but put them on. Following safety guidelines is good both for workers and supervisors. Later, the system will be supplemented with a predictive analytics module able to prevent future accidents by analyzing minor incidents from the past.

Helping band

Smart bands have been used at the Angarsk Electrolysis Chemical Plant (AECP, a

subsidiary of Rosatom's fuel division) since September. Their essential function is to send alarm signals when away from any other communications equipment. These gadgets also have pulse measuring and GPS functions. The bands were pre-programmed by AECP engineers.

Staff who work shifts is the primary employees to wear the wristbands. According to developers, operators working alone could be found at any nuclear facility, not just at AECP. Smart bands transmit data to the workstation of the shift supervisors and to the plant's data center where the signals are processed and responded if needed.

Fortunately, there were no incidents or accidents at AECP during the test run. The tests were found to be successful, and TVEL management decided to roll out this initiative at other companies of the division, including Siberian Chemical Plant and Chepetsk Mechanical Plant. At the AECP itself, the smart bands will be distributed among more than 200 workers.

Information about the worker's pulse and, later, blood pressure, is a health indicator and its change stimulates to pay more attention to one's life style.

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Large gadget for a fitter

Rosatom's subsidiary Start Production Association manufacturing special-purpose machinery, has developed an automatic tool management system. It consists of tool distribution, collection and management modules. The first two modules are storage cabinets where tools are kept. The third one is a display giving access to the system's interface. The user who takes tools from the cabinet is identified with a bar code or with a login and password. The cabinet could keep up to 1,147 tools. The system tracks availability of tools and analyzes how often each tool is used. Accumulated data could be structured and used to make utilization and procurement forecasts. NL

Rosatom Tames Digital

Digitalization is a major driver for the Russian state nuclear corporation. Rosatom digitalizes its internal processes, develops digital products for sale and assists the Russian government in creating high technology products, for example, quantum computing.

Rosatom's digital development strategy was approved in late 2018. The strategy covers three areas. First, it focuses on internal needs of the company, particularly cost reduction and performance efficiency. Second, the strategy provides for the development of digital products targeting mostly external customers. The goal here is to increase Rosatom's revenue. Third, Rosatom takes part in creating digital infrastructure and delivering national digitalization projects initiated by the government.

Modernization from inside

Rosatom is a leading Russian developer of software for its core business activities, including nuclear construction management, safety and operation of nuclear power plants.

Some of its software products are more specific and intended to cut costs. One of them helps Atomenergosbyt (a Rosatom Group retail electricity provider) process incoming customer calls.

In Russia, customers usually provide meter readings by phone on the designated days every month. As a result, Atomenergosbyt's call center receives too many calls on such days, and customer experience problems getting through. However, hiring additional staff just for the sake of those several days is not an option. In order to overcome these issues, the company introduced robotic call processing. The bot operates in a multi-line mode and processes many more calls than a human operator processes. As of early

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December 2019, bots answered 51% of all calls, with the number of lost calls reduced by a third.

Another Atomenergosbyt's initiative will enable it to identify retail customers using facial recognition (see Face to Face with Customers).

Digital image processing could also ensure that staff clothing meets safety requirements. The Kola NPP was chosen as a test site for the new technology. In order to produce a data set, technology developer Rosenergoatom processed 37 hours of video records showing correct and incorrect use of personal protective equipments.

Rosenergoatom also used AI to develop a 'corporate Google', an internal content-based search engine. Its development began in 2016, with 300,000 documents loaded into the system. By now, the number of documents has approached 8 million.

Another project developed by Rosenergoatom concerns speech recognition and simultaneous interpretation. With this

software, an operator speaks Russian while an intern standing nearby has the text recognized and translated on the tablet.

Rosatom's TVEL Fuel Company uses digital text processing to facilitate procurement procedure. Special algorithms analyze unstructured text of specifications and terms of reference for about 90 criteria and identify simple (spelling and punctuation) and complex mistakes (references to national standards and other regulations, proper names, compliance with Rosatom Procurement Standards, etc.). Statistics show that the system's suggestions are about 80% correct.

The next step is price analysis. The system searches dedicated websites for price offers and automatically sends RFPs to suppliers. Price proposals are then analyzed for certain criteria, and the system generates reports on the contract price.

Practice shows that the cost of labor to calculate the contract price has decreased 16-fold; experts spend 30% less time on reviewing the terms of reference and specifications. The system is expected to reach its full potential in 2020-2021.

In late 2018, ARMZ Uranium Holding launched the Smart Mine project at Khiagda

Face to face with customers

The Face ID function is planned to be launched in 2020. It will be used to provide service to some customers remotely and reduce time spent by the customers in the office. Time reduction will be achieved through an AI-enabled facial recognition. Thanks to the technology, customer identification requires no personal account number, address or ID document. Facial recognition is expected to reduce service time per customer by nearly 19% or 110 seconds.

(Buryatia). The Smart Mine is a software package that simulates in-situ leaching processes in uranium mining. Some of the Smart Mine components are also used at the mines operated by Dalur. One of them is Hard Hats, which we described above.

All the digital initiatives mentioned above create a safer working environment for Rosatom's employees, save time and reduce costs.

Rosatom's product display

The second area of Rosatom's digital activities covers development of software programs for external customers. In 2019, Rosatom Group companies created three digital products for sale.

Zababakhin Russian Research Institute of Technical Physics developed the Volna information system for gas pipeline management. It has been installed on the Power of Siberia gas pipeline.

Unlike similar systems, Volna simulates gas pipeline operations in a variable mode, with gas added into and taken off the pipeline. The system developed by Rosatom also allows for input of new data without waiting for the results of current calculations. In addition, Volna is able to account for pressure variations in the pipeline due to relief irregularities. Finally, the system is capable of forecasting pipeline conditions. Using the forecast, dispatchers can proactively control the pipeline and prevent unwanted consequences.

In 2019, engineers of the Russian Research Institute of Experimental Physics created Logos Heat, an off-the-shelf software product, i.e. a program that can be downloaded, installed and used as is. This is the second product in the Logos series. The first programme, Logos Aero Hydro, has been available on the market since December 2019, while the third one, Logos Strength, will be launched in 2020.

Logos Heat is designed to solve engineering tasks related to the assessment of thermal performance in different assemblies and components. Apart from the nuclear industry, such tasks need to be solved in the design and production of aircraft, engines, transport machinery and other industries. Logos Heat can also be interesting for oil producers. Currently, 70 Russian companies use the software.

Another product created by Rosatom is an online shop selling technical documents. Launched in September 2019, the shop targets companies seeking to obtain licenses and permits for nuclear construction. They include Russian and foreign construction companies, nuclear operators and engineers. The shop contains more than 700 technical standards and regulations related to Generation III+ nuclear reactors constructed by Rosatom abroad. It also contains over 400 R&D documents prepared as part of safety assessment of design solutions.

At present, Rosenergoatom is obtaining permits to upload engineering design, commissioning and quality assurance documents. When needed, the purchased document could be translated into English and delivered as a hard copy. A subscription option for customers to receive updated versions of the purchased documents is under consideration.

On a national scale

Rosatom is involved in the delivery of government-initiated digitalization programs. In particular, the state nuclear corporation took part in drafting roadmaps for the development of seven overarching technologies (see Digitalization Roadmaps). The roadmaps were approved by the Ministry of Digital Development, Communications and Mass Media of the Russian Federation in October 2019.

According to the agreement between the Russian government and Rosatom, the nuclear corporation began to develop a quantum computer. Quantum computers are capable of solving computational tasks in the field of cryptanalysis, complex system modeling, machine learning and artificial intelligence much faster than conventional computers.

Rosatom is engaged in the development of new production technology. It is defined by the Ministry of Digital Development as 'a combination of new, high-potential and rapidly developing but not yet widely adopted approaches, materials, techniques and processes used to develop and manufacture globally competitive products (machinery, systems, equipment, devices, installations, etc.)'.

Digitalization roadmaps

1. Virtual and augmented reality technology
2. Quantum technology
3. New production technology
4. Wireless communication technology
5. Distributed ledger technology
6. obotics and sensorics
7. Neurotechnology and artificial intelligence

"We have a long track record in solving complex technology tasks. There is a large number of perfect technical solutions employing information technology, such as those used in engineering design, product life cycle management, process management, communications, cyber security and many more areas," said Ekaterina Solntseva, Director for Digitalization at Rosatom, speaking at the digitalization conference dedicated to the corporation's performance in 2019.

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