LEAD STORY

Sibir Icebreaker to Float Out Soon

A historic event will take place in late September as the Sibir (Siberia) nuclear icebreaker will be put afloat in St. Petersburg. The float-out ceremony is scheduled for 22 September. This was announced by the Baltic Shipyard (a subsidiary of United Shipbuilding Corporation).

Sibir is one of Project 22220 icebreakers designed to reinforce Russia's leadership in the Arctic. Capable of breaking three meter thick ice, these vessels will escort ship convoys through the Arctic Ocean. They will assist oil tankers and gas carriers in transporting hydrocarbons from the Yamal and Gydan Peninsulas and Kara Sea offshore deposits to the Asian-Pacific markets.

The double-draft design allows for the operation both in Arctic deep waters and estuaries of polar rivers. The Project 22220 vessels will be powered by two nuclear reactors, with the 175 MW RITM-200 propulsion unit acting as a primary source of steam. They will become the world's largest and most powerful (60 MW) nuclear icebreakers. All Project 22220 vessels will measure 173.3 meters in length and 34 meters in width, displace 33,500 tons of water and have a crew of 75 people.

A few days ago, ZiO-Podolsk (a subsidiary of AEM, Rosatom's mechanical engineering division) finished hydraulic tests on the first reactor vessel to be used in Sibir's RITM-200 propulsion unit. Being the final step of the reactor vessel production process, the tests serve to confirm the product quality and provide a guarantee of seamless operation in future.

Hydraulic tests are one of the most frequent quality control procedures used to check whether equipment working under pressure is hermetically sealed.

The reactor vessel was tested by inducing internal condensation under the air pressure of 270 atmospheres. After the pressure fell to 220 atmospheres, experts examined the vessel for deformations and leaks by exposing it to UV radiation and using luminescent detection techniques. The results confirmed robustness and reliability of the reactor.

The first RITM-200 reactor was manufactured at ZiO-Podolsk for the flagship Arktika nuclear icebreaker in 2016. It is expected to be fully commissioned in 2019, said Rosatomflot's CEO Vyacheslav Ruksha at the Arctic Council Ministerial Meeting. He also said that the design of the Lider (Leader) icebreaker and relevant ice tests would be completed by the end of the year. The icebreaker will be capable of making its way through the ice at a speed of 12–14 knots.

INTERESTING FACTS

A short time ago, 50 Let Pobedy, another Russian icebreaker, set a speed record en route from Murmansk to the North Pole. The journey to the North Pole was dedicated to the 40th anniversary of the first voyage to reach the northernmost point of the globe. The nuclear-powered ship left Murmansk and reached the North Pole in just 79 hours. In 1977, it took the icebreaker 176 hours to get to the peak of the planet. The voyage of 50 Let Pobedy was the 124th in the history of sea journeys to the North Pole, 111 of which were done by Russian and Soviet vessels. At present, the plant is preparing to run a fit-up test on RITM-200's vessel and internals. The service life of the new reactor is 40 years.

TECHNOLOGY

World's Most Powerful X-Ray Laser Inaugurated

The world's most powerful X-ray laser was inaugurated in Germany. It was created with the substantial contribution from Russian nuclear experts.

The European XFEL (European X-ray free electron laser) produces extremely bright and ultra short light pulses. The facility can generate up to 27 000 pulses per second – 200 times more than other X-ray lasers. With the help of specialized instruments, these X-rays enable completely new insights into the atomic details and extremely fast processes of the nanoworld. For example, such X-ray flashes could be used to map the 3D structure of biomolecules and other biological particles with previously impossible speed and precision. Furthermore, single snapshots of particles produced with the X-ray laser can be spliced into 'molecular movies' to study the progress of biochemical and chemical reactions. This will greatly facilitate the development of new medicines and therapies, more eco-friendly production methods and technologies for extracting energy from sunlight. The new laser could also be used

in material science as a tool for development of new materials and substances, optimization of storage media for computers or research into extreme states of matter such as those found on some exoplanets. The XFEL project is based on the solutions devised by Russian scientists and taps to Russia's expertise and finance. According to Mikhail Kovalchuk, President of Kurchatov Research Institute, it is the first time that Russia, apart from being a full-fledged member of the large international research project, has taken the lead in it. "The design of the device is based on the ideas of Soviet and Russian physicists. Russia has thus contributed its expertise and intellectual property to the XFEL project. The foundation of the project was laid by an article published in 1980 by researchers from Novosibirsk. The project also benefits from our human resources as hundreds of our experts are engaged in the work. The Kurchatov Institute has an unparalleled experience in the construction of large irradiation facilities and research in the field of X-ray, synchrotron and neutron radiation. We also make an input in the research by supplying ready-made solutions, systems and devices – this is our in-kind contribution to the project. Finally and more importantly, it is the first time that we act as full-fledged financial stakeholders in a large-scale international research project," Mr. Kovalchuk explained in an interview to RIA Novosti.

Almost 300 institutes from 36 countries are engaged in the project. The stakeholders from Russia include Kurchatov Institute (based in Moscow, Protvino and St. Petersburg), Institute for Nuclear Research of the Russian Academy of Sciences (Moscow), Institute of Crystallography of the Russian Academy of Sciences (Moscow), Budker Institute of Nuclear Physics (the Siberian branch of the Russian Academy of Sciences, Novosibirsk), Ioffe Institute (St. Petersburg), Rosatom's Efremov Research Institute (St. Petersburg), Joint Institute for Nuclear Research (Dubna), National Nuclear Research University, Moscow Institute of Physics and Technology, Moscow State University, etc. According to Mr. Kovalchuk, the key asset of the free electron laser – its beamtime – will be allocated in proportion to the contributions made by each stakeholder country. Russia's input is only second to Germany's. "After Germany, Russia has the second largest amount of researchers involved in the XFEL project. We have also filed the third largest amount of applications for the first experiments at XFEL," Mikhail Kovalchuk said

The capacity of the new laser is 200 times higher than that of its forerunners. Due to this fact, researchers are now able to record the so-called "molecular movies" that for the first time in history allow for making shot-by-shot breakdowns and viewing the molecular structures with the highest possible precision. According to Dmitry Khakhulin who is engaged in the research at XFEL, this process can be compared to watching a football match. "We can compare it to a football game. Let us take the game between Germany and Brazil played a few years ago as an example. Suppose we saw the game kick off and the final score, but do not know how it happened because we missed the main part. To see the main part in a chemical reaction and get a step-by-step picture of the process, we need to carry out experiments using a detector and high-resolution cameras as those installed in the free electron and optic lasers," he explained.

CONSTRUCTION

Safety System Tested at Leningrad II

One of the most important safety systems of passive heat removal was successfully tested at Leningrad II Unit 1.

"The passive heat removal system (PHRS) utilizes steam generators to remove residual heat and cool the reactor core in beyond design basis accidents that cause electricity cut-offs or a total loss of feedwater," explains Vitaly Shutikov, Head of the Reactor Department at Leningrad II, which is now under construction. "The system is unique for its ability to operate independently. It is designed to ensure sustainable removal of residual heat from the reactor core through three of four independent channels for at least 24 hours. As for now, all of the four loop channels have passed quality tests and are ready for use. They will be kept in standby mode as long as the unit is in operation." The PHRS is one of the most important components of a nuclear power plant as it ensures safety of nuclear reactor operation in emergencies. Passive heat removal systems have been installed at Kudankulam (India) and Novovoronezh II (Russia), and are provided for in the design of Akkuyu (Turkey).

PHRS tests were carried out as part of hot functional tests meant to ensure that the core equipment as well as auxiliary and safety systems of Leningrad II are functioning as designed. Hot testing is the last major step before the start-up of the unit. "The loop channel ensures coolant circulation through the steam generator and the multi-sectional heat exchanger, which is placed inside the emergency heat removal tank and connected to the steam generator through inlet and outlet pipes. The emergency heat removal tanks are located at Level +59.850 m in the dome section of the reactor building. As they are positioned well above the steam generators, the coolant circulation in the loop is induced by gravity. "The tests have proved that the system is fully operational and capable of removing residual heat and cooling the reactor core in case of a total blackout at the plant," said Alexander Nakonechny, a shift supervisor at the Reactor Department of Leningrad II.

Hot functional tests are conducted to check the core equipment and systems for compliance with design specifications and prove their readiness for commissioning and fuel loading. Successful hot tests will therefore mean that Unit 1 of Leningrad II is ready for fuel loading. The nuclear station has already passed almost a half of 78 functional tests.

FOR REFERENCE:

Leningrad NPP operates four 1000 MW reactor units. The plans are to replace this capacity with two VVER-1200-based units of Leningrad II, which is now under construction. VVER-1200 is Rosatom's flagship reactor based on the AES-2006 design featuring a number of definitive advantages over the VVER-1000 reactor. In particular, it offers a 20% higher power capacity and a doubled service life (60 vs. 30 years) of its core components, reactor vessel and steam generator body. More

important is that the new design is fully compliant with the post-Fukushima safety requirements.

The Russian AES-2006 design features an array of unparalleled safety systems. One of them is a core catcher, a unique safety device designed by Russian nuclear engineers to mitigate effects of a nuclear meltdown. In case of an accident, the core catcher medium mixes with the molten core materials and distributes them evenly inside the catcher body. The catcher can hold the molten core for an unlimited period of time, preventing nuclear materials from getting outside. The first ever core catcher was installed at the Russian-designed Tianwan Nuclear Power Plant in China. Passive heat removal is another unparalleled safety feature of the AES-2006 design. This technology allows for cooling of the reactor core in case of power outage without human involvement.

The world's first Generation 3+ reactor has been commissioned at Novovoronezh II. New safety systems, increased service life of the primary equipment and improved automation solutions significantly reducing the need for manpower will almost double the cost efficiency of Novovoronezh II.

IN BRIEF

WANO Assesses Readiness of Rostov Unit 4

A pre-startup peer review was completed by the World Association of Nuclear Operators (WANO) at the Rostov nuclear power plant in early September.
A group of WANO experts from Russia, Belarus, Ukraine, China, Korea, France, Slovakia and Canada assessed operational readiness of Unit 4. Vasily Aksyonov. Director of WANO Moscow, expressed an opinion that Unit 4 would be as safe and reliable as all the other units of Rostov NPP. "My confidence in safe operations of the new unit is supported by a number of facts. First, I rely on the results of the WANO peer review of Unit 4. Second, it is the fourth reactor unit that has been commissioned in Volgodonsk since the beginning of the 21st century. It will be operated by a strong team of experienced nuclear professionals. If the Government decided to build four more units, the Rostov team would be even stronger," Aksyonov said. Andrei Salnikov, Director of Rostov NPP, thanked the experts for their work and stressed that the joint efforts of international experts and the local team contributed to safety of the nuclear plant. Unit 4 is scheduled to go critical in 2017.

Targets Overachieved by Russia's Nuclear Plants

This August Russian nuclear power plants exceeded their power generation targets. Last month Balakovo NPP produced 2,930.78 million kWh of electricity, or 102% of the August target (2,873 million kWh), with the power surplus reaching 57.78 million kWh. Kola NPP generated 556.5 million kWh of energy in August 2017. For the last 8 months, the plant produced 6,544.1 million kWh, or 102.4% of the targets set by the Federal Antimonopoly Service. This means Kola generated additional 152 million kWh of electricity with the capacity of 840 MW. Finally, Rostov NPP produced 2,204.6 million kWh in August and thus overachieved the month's target (2,162 million kWh) by 102%.

Global Nuclear Trends to Be Discussed in September

Two international nuclear industry events are traditionally held in September. On

13–15 September, London will host the World Nuclear Association Symposium. This is the most important annual event for the global nuclear industry, bringing together hundreds of nuclear energy experts from all over the world to discuss a wide range of issues. The symposium will provide unique opportunities for establishing business contacts and information exchange, among them an exclusive gala dinner and an exhibition of major suppliers and utilities. The two-day event will be attended by 600 nuclear professionals, industry reps from 30+ countries and high profile speakers. On 18–22 September 2017, the 61st IAEA General Conference will be held in Vienna. As part of the conference, a scientific forum entitled Nuclear Techniques in Human Health: Prevention, Diagnosis and Treatment will take place on 19–20 September.